PRACTICAL NOTES ON HYDROGRAPHIC SURVEYING FOR ENGINEERING PURPOSES.

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If a survey of a harbor or river is to be made which shall form the basis for contemplated improvements, either by dredging, blasting or other means, it is essential that it should be reliable in every respect. All the data collected and shown on the map—the shore-lines, soundings, the obstructions to navigation, as bars, sunken ledges, bowlders, etc., should be located and delineated correctly, and guess work, too often resorted to, should never be allowed.

The value of such a survey depends entirely upon the accuracy of the soundings and their location, in reference to established known points or beach marks on shore; therefore *all* soundings are taken on ranges established for that purpose, and *each* sounding is located by intersection with transit instrument from suitable stations, as later described. It is the object of these notes to show how such a survey is made in a satisfactory manner, containing results which have been accumulating during many years of service in this class of work.

The method, which we shall call the Fan system, has proved itself, by judicious management, extremely flexible in adaptation to the ever-varying localities; it offers many advantages and fulfils the requirements of such a survey better than any of the numerous methods generally employed. In tidal rivers and harbors, mean low water is usually adopted as the plane of reference, and if not already known, we have to establish this important part of the work at once.

A tide-gauge, clearly marked in feet and tenths of feet, is securely fastened at some place convenient for observations, where the water-surface is sheltered from wind and waves. The zero of this gauge should be below the lowest low water, and the gauge long enough to project above the highest tides. It should be referred by level, *at once*, to a distinct mark on one or more objects, not likely to be removed or demolished. A sketch of the location of these marks should be made, and their elevations above the zero of the gauge recorded. Observations of the high and low waters are at once begun, and continued day and night for one lunation (29 days) at least. The observer, who must be thoroughly trustworthy, should record from 3 to 5 tenths of rise and fall (or vice versa) before and after every high and low water, note the time, and also keep a record of the force and direction of the wind.

From these observations the mean high and low water levels are deduced, and the reference of the bench-mark corrected accordingly. This work should be closely watched by the chief of party, who should also personally look to the correct establishment of the bench-marks, the most important part of the work.

Next we select a suitable place for measuring a base-line. If, as often happens, this line will have to be measured some distance from shore, it is not necessary or desirable to preserve it; but, instead, two of the triangulation points, which can or must be permanently marked, and from which as many of the other triangulation points as possible can be seen, are used for bases. The distance between them is determined by triangulation. The line should be measured twice, as accurately as possible, with a standard steel tape, making the proper allowances for difference in temperature. If the ground on which the line is measured is not practically level, the elevations of all the stakes used must be determined by leveling, and the line reduced to the horizontal. Select a cloudy day for this work (the measuring of the line), on which the difference between the temperatures of the air and the ground, upon which the tape will rest more or less, are more nearly alike than on a hot, sunny day.

The establishment of all the triangulation points, which is next in order, should be done in such a manner that they will answer another purpose also, which will be explained forthwith. As far as triangulation is concerned, they should be such distances apart as to give good intersections (not less than 30°), command a fair view upon the water, and to as many other triangulation points as possible, and be near enough to each other, so that the intervening shore-line, etc., can be reached easily and connected by telemetric measurements from the adjacent stations. That some of these points should answer the second requirements, viz: as centers of convergence for a number of ranges for soundings, they must be located at places where an open space or clearing (behind or in front) will make this possible. All the triangulation points should be established at once and marked permanently if possible. A drill-hole in a ledge or some small boulder sunk in the ground for the purpose is best. For want of either, a copper nail in a good stake, driven a little below the surface of the ground, must do. Erect at once small signals over them, large enough only to be distinctly seen with the instrument; they will save a great deal of time and vexation during triangulation. Have a number of the signals made beforehand, from one inch square stuff, two to four feet long, painted red. To a crosspiece on top tack a piece of cotton cloth a foot square, and fasten the lower edge with a few tacks to the upright; it will keep the flag spread. Should small braces be needed (for signals over stakes) use cord instead of nails, so that they can be taken down and put up in a moment. The stations are designated on one side of the harbor or river by Roman figures, on the other by letters, and they should be marked in the field accordingly with good paint—it prevents mistakes. A small rough sketch should be made during this work, showing location and describing the nature of the station, whether drill-hole in ledge or boulder, stake, etc. After completion of this work we are thoroughly acquainted with the shore lines and appearance of things generally. We are ready now to commence the triangulation. It is advisable from the start to do this work diligently without hurry; it pays at the end and saves time. To find that a mistake has been made in an angle at any one station is extremely aggravating when discovered in plotting the triangulation. From the station occupied angles to all visible stations should be taken (they give a good check upon the work) including the bearing of the magnetic needle, with reference to the zero of instrument. A good number of prominent fixed objects on shore, church steeples, tall chimneys, cupolas, or chimneys of isolated buildings, lighthouses, buoys, etc., should be included in the triangulation; they are, as we shall see later, very useful as backranges in case of emergency, for indicating sailing courses, and for other purposes.

The instrument, during this work, should be carefully protected from the sun's rays by a large umbrella. In larger surveys using a transit reading to single minutes only, the angles should be repeated twice or four times. It consumes much time, but assures greater precision and detects mistakes at once. We come now to a part of the work which is as disagreeable as it is essential to a good systematic hydrographic survey. This is the plotting at night (generally by poor illumination) of the work done during the day. At least a rough plot of the triangulation points must be made now. We shall need it many times daily during the entire survey. We can now lay out upon this sheet, with a protractor, range-lines for sounding, radiating from suitable triangulation stations in the shape of fans. The last range of each fan is the first range in the next one, having its centre on the opposite shore. The whole area to be surveyed is thus covered evenly and as closely as deemed necessary. If later soundings, taken on these *general* lines, indicate any shoals, ledges or other obstructions which need further investigation, more ranges can be interpolated to cover those questionable places and soundings taken as close as desired.

The bearings of the ranges thus laid out on the sheet are noted and established in the field accordingly. Stakes marked to correspond with the numbers of the range lines on the map are driven for this purpose far enough from the station to give quick acting ranges, that is, they should show any reasonable deviation from the line at once to the leadsman. A nail should be driven in each stake to indicate the line exactly. It is not necessary to lay out all the ranges at once; there will be chances enough to keep them ahead of the sounding. It will be seen that thus all the range-lines are laid out from triangulation stations only, and that they can be re-established without any trouble and in a short time, providing proper care has been taken to mark these comparatively few points permanently in the first place. Sometimes it happens that certain areas cannot well be reached by these fan ranges, in which case it is an easy matter to fill such gaps by ranges running from one to another of the numerous telemeter stations later to be established. For the work done so far, only three men were employed beside the chief. The duties of these three men in future should be those of leadsman, boatman, and signalman, as they have to be and are, by this time thoroughly acquainted with all the triangulation points and ranges, etc. In order that they may be qualified to perform these functions, care must be exercised in their election. The boatman, and especially the leadsman, should be entirely trustworthy and intelligent men.

For sounding, the boat crew consists of leadsman, one boatman (except in quick water and extensive surveys, when two are employed) and a recorder.

Beside, we need the signalman who attends to the shifting of the range-poles, and a tide-observer. The latter commences work at a stipulated time and continues until the boat-crew returns. In most cases the observer, already employed (for observing the high and low waters) is willing, for an increase of pay, to take the tide while sounding is going on. He takes the rise and fall of the tide for every tenth of a foot, and notes the exact time.

To the signalman should be given a memorandum stating the numbers of range-lines in the succession they are to be sounded, and he should check the number of each range as soon as sounding is completed. He should set up the range-poles plumb and exactly on line. The completion of sounding a line is indicated to him by the leadsman, who waves the flag in a half circle, until he sees one of the range-poles taken down. If the range-stakes are far enough apart, so that no confusion will occur by erecting the range-pole for the next line, while one is sounded, he should invariably do so, as much time is saved by it. The duties of the recorder are as follows: Before commencing to sound a line, he should hold up a flag, to indicate that everything is ready. Upon the return only of this signal by the observer, sounding may commence. He notes and numbers the soundings as given to him by the leadsman, and at every 5th, 10th, 15th, etc. sounding—a moment before it is to be taken—he raises his flag for a few moments. These signals are not answered, but noted by the observer. They only serve as a check upon the work. Should at any time one or more angles be missed, by reason of passing or anchored vessels obstructing the view of the observer, or a sounding is forgotten to be recorded, such discrepancies can be remedied inside of five soundings, and the line need not be condemned as doubtful. He should also closely watch the observer, who regulates by signals, especially at the start, the distances between soundings. Raising both arms above the head, or extending them horizontally, are the signals we use to indicate "nearer together," or "further apart." Upon seeing one or the other, he should inform the boatman at once.

If the man we have engaged as boatman turns out to be such, we can consider ourselves lucky. To pull a boat for sounding is by no means done as easily as it appears, and unless it is in the man naturally, you seldom can teach it to him. A good boatman will handle a boat under the constantly varying conditions of currents and winds as gracefully as a swan handles itself; he will stop the boat at regular intervals on the line, and keep it

there long enough to have the sounding taken. He is the man, by whose good work time and money and an enormous amount of vexation is saved. In the first place the boat is pulled the distance the soundings are desired to be apart; arrived at this point, the stern of the boat, where the leadsman stands, should be *on range*, and the boat be at a stand-still. Both boat and leadsman watch the ranges sharply, and should the boat not be on line exactly, the leadsman gives the final directions. After a little practice, a good boatman will not only do this whole operation quickly, but will also do it easily. By taking into proper account—and advantage of—the wind, or the current, or both, sounding can be carried on when a less experienced boatman could not keep a boat anywhere. In still water, and without wind, of course, the boat can be pulled direct on the range, and stopped there for each sounding, without shearing off and on the range, scallop fashion.

The leadsman's duties may be summarized as follows: First, he should never take a sounding unless it is exactly on range; second, always take plumb soundings, and third, should read off the soundings correctly. Besides these principal points there are others which are very essential, in fact, necessary to do good work. All his movements should be as regular as clock-work, and alike for each sounding; it helps the observer very much to know by these movements, especially when the boat is a mile or two away, when a sounding is to be taken. The leadsman occupies the stern of the boat, left foot down, the right foot on the seat. When nearly on the range he lets his sounding lead run to the bottom. The moment he is on the line, he squats down on his right foot, and takes hold of the lead-line at the water's edge (holding the line taut with the left hand). This done, he immediately lifts his left arm over his head for a few seconds. This signal, and the intersecting, by the observer, of the leadsman's right hand is simultaneous. He then stands erect, reads off the sounding from where his right hand has hold of the line, and calls it to the recorder, who should repeat it. He should also frequently give the nature of the bottom as soft, sticky, hard, rocky, solid ledge, etc. In taking soundings very close together, the lead is not hauled in at every sounding. The leadsman especially should also watch that the distances between soundings are regular.

Having gone through the routine work, to be performed by every member of the crew, it remains to be seen what the chief of the party has to do. It may be mentioned here, first as well as last, that his duties are manifold, and will require every moment of his time, day as well as evening, if he intends to be always ready and make the best use of the time and the weather. Having completed the plotting of the triangulation and decided upon and laid out on the map the general system of ranges, also located a sufficient number of them in the field to be ready for sounding, a list of all the ranges should be made out (in the back part of the angle book, for immediate reference), headed with notes showing from which triangulation stations the several fans of ranges, or parts thereof, are to be intersected; also what stations shall be used for zero of instrument.

Close in shore, where the range-lines converge closer and closer, it is useless to sound them all.

We therefore take soundings to the shore on every second, third and fourth, etc., line only (to be determined on the map), and limit the others in such a manner that the soundings will be about equal distances apart. These limit angles are noted behind the respective numbers of ranges in the list. Later we probably shall need limit angles (two for each line) for sounding on interpolated ranges, to cover shoals, sunken ledges, or other obstructions, which will require special surveys. This list should be announced every night, as the work progresses, so as to give quite a choice of ranges to select from. It will be found that frequently the programme for work, made up at night, must be changed the next morning in the field, on account of the wind and weather. In such emergencies this table is of the greatest value; from it we can select such work which can be done favorably under the prevailing circumstances, and many hours, otherwise lost, are utilized during a survey.

All the men being properly instructed in their respective duties, and sent to where sounding is to be commenced, the tide observer's watch compared, we will see how everything works together.

The signalman erects the front or back range (the centre range, as the case may be) plumb and braces it, if necessary, so that it may not tumble over during sounding; then he sets up his other range at the stake, called for in the memorandum. Meanwhile, the observer has occupied the station given in his table as intersecting station for these lines. Having levelled the instrument and pointed its zero on the proper point, and being otherwise ready, he waves his flag to the recorder. The boat being on range (near shore), the recorder returns this signal, and sounding commences. All the soundings are now intersected by the observer; every full minute of time is noted behind the sounding taken at that time, from a timepiece placed conveniently on the instrument. The recorder's signals, indicating every 5th, 10th, 15th, etc., sounding, should correspond with the same number of angles taken; if not, at any time, correct at next flag. If the distance between soundings does not agree approximately, at least with that given to the leadsman, the observer gives the signal "nearer" or "wider" apart to the recorder, who is watching him between noting the soundings, and informs the boat and leadsman at once to that effect.

The known length of the boat serves here as a guide. If all works satisfactorily, and the boat and leadsman understand their business, lively work is in store for the observer.

He will have little time left to contemplate upon his lame back, generally the result of the first few days' work. With a new crew, nine times out of ten, the first few lines or a forenoon's work will have to be done over again, and here, patience is recommended. If the men are smart, it will go well from the start and better at every line. Insist from the first, that the boat is brought to a stand-still at each sounding, that the leadsman is careful to get plumb soundings and *always* at each sounding lift his left arm determinedly above his head, also that the recorder shows his flag as instructed. The men are apt to grow slack in these things unless kept to it from the beginning. As soon as sounding a line is completed, the leadsman waves his flag; the signal man changes his range-pole, and the new line is sounded on the return trip. If lines are short and soundings are to be close together, as in detail surveys of ledges or small shoals, for instance, the soundings can be taken at more regular intervals, by beginning them all on one side, working against wind and current, if possible. With an experienced crew in *general* sounding, 4 to 8 soundings, and in special surveys, where soundings are from 2 to 5 feet apart only, up to 10 soundings per minute can be taken. The latter number, however, is a maximum attained only by long practice, as more than ten angles cannot well be taken, read, recorded and the time noted in less than a minute. Soundings should now be done at every possible chance, and when this is impracticable on account of high wind, strong tides, etc., the shoreline survey is fallen back on, to fill out the time. For this purpose it is well to *always* carry the telemetric and other necessary tools along in the boat, so that whenever sounding has to be discontinued (mostly on account of strong winds) this work can be taken in hand at once.

Shield the instrument with the large umbrella from the wind, and the telemetric work can be done as well, even better, than on a fine sunny day, when the motion of the heated air makes reading from telemeter difficult and uncertain.

It is advisable not to be stingy in the shore line survey; but sight at all objects, possibly of any use in future. All houses within easy reach of the telemeter, wharves, fences—all projecting points, isolated trees, the bench-marks and location of tidestaffs should be taken, and whenever possible, these telemeter stations should be marked by a small cross and running numbers (between each two triangulation stations) with good (red lead) paint. All these points tend to make up a complete and accurate map of the survey, and may come very handy at some future time. At triangulation stations, which are likely to be occupied but once (when triangulating), it saves time to complete the telemeter work at that time. To avoid the great annoyance caused by the reflex of the sun on the water—often so blinding that the ranges cannot be seen from the boat—we must arrange our work so that the ranges for lines to be sounded in the forenoon are on the north or west shore of the water sheet, and those for the afternoon's work on the east or south shore. It is impossible here to mention the many ways which can be made available to nicely cover a certain area with range lines. Suffice it to say, that however badly the chances for fan-ranges look at first, a discriminating eye and good judgment will find them before the triangulation is completed. Very rarely, however, we may be obliged to use for back ranges suitable points of our triangulation, back from shore, such as chimneys or corners of buildings, steeples, isolated trees, etc. In such a case a nice pair of ranges is established by locating the front ranges along a straight line between two known points by measurement, or by using the telemeter stations along the high-water line direct.

If the special purpose for which the survey is made is known, which is most always the case, the character of the bottom at such places where improvements are projected should be examined by borings, otherwise they should be made generally over the area covered by the survey.

The velocities of the currents should be determined at least approximately, unless for some special purpose they are required to be minute.

Having thus given a general sketch of the field work, a few words in regard to plotting the work may not be out of place here.

We suppose the triangulation has been plotted and the ranges laid down, numbered and the limits for sounding (if such are necessary) marked and noted. Through this work alone we are assured that we shall cover the ground satisfactorily with soundings, even if they are not plotted at the time. In order, however, to get a general idea of the bottom, it is to be recommended to plot a few lines of soundings, at least, of each day's work. It is very essential to glance over the soundings after each day's work. Plot and reduce (to an approximate plane of low water, if the true plane of reference is not yet known) those soundings which indicate shoals dangerous to or obstructing navigation.

Should closer investigation of such shoals be deemed necessary, we interpolate a few more ranges at either side of the supposed shoal, and sound only those portions of these lines as are believed to cover the same. Should closer soundings be required we repeat the same operation, developing thereby the characteristics and limits of such shoals to any degree of accuracy. The soundings are thus taken only where necessary and much time is saved. These especial surveys are carried to such an extent that accurate estimates as to quantity and quality of work can be made of them. It is advisable to plot a survey to such an extent (in the field) at least, as to give positive assurance that every doubtful point is satisfactorily covered, a work which can be done in a few hours every evening. We have plotted *all* the work in the field for years, but, however, great the satisfaction of bringing home a complete field-sheet of survey, have come to the conclusion that this is impracticable and the continuous night work highly injurious to the eyes.

Before concluding we would call attention to the instruments and tools proved to be most convenient. The transit (for intersecting soundings) should have one vernier only (under the eye-piece of the telescope) so that angles can be read very

quickly. The graduation should be coarse enough to be easily read with the naked eye. It should be fitted with horizontal cross-hairs (adjustable if possible) for using the telemeter, a most valuable requisite in hydrographic surveys. For the constantly varying line a sounding *chain* has been substituted. We use brass jack-chain, No. 12 wire; the ends in each link being nicely soldered before using. The lead should weigh from 8½ to 12 pounds. Seven or eight fathoms of chain are sufficient for most work. For deeper water a piece of codline may be spliced to it. It is marked as follows:

1 fathom, a piece of red flannel.
2 fathoms, a piece of white flannel.
3 fathoms, a piece of blue flannel.
4 fathoms, a large leather tag with one hole.
5 fathoms, a piece of red flannel.
6 fathoms, a piece of white flannel.
7 fathoms, a piece of blue flannel.
8 fathoms, a large leather tag with two holes.

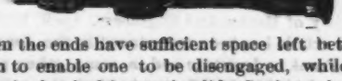
Each foot is marked by a leather strip $\frac{5}{16}$ in. wide, about 4 in. long. To attach them, so that they will not work out during sounding, which they will do otherwise and cause annoyance and delay, cut a slit about 1¼ in. long (button hole shaped) into one end; stick this end through the respective link of the chain, and then at once through the slit—far enough to pull the long end through the slit in this projecting end. This fastening will hold as long as the leather lasts. A sounding pole, needed for closely surveying sunken ledges, can be quickly made as follows: Into a planed seasoned spruce pole, insert a ⅝ inch round steel rod from 4 to 6 feet long, having a collar weld on about 8 inches from the end; drive this into the double iron banded end, and mark the feet and tenths on the pole (having one side flattened for this purpose as well as to enable the leadsman to feel where the marks are and keep them towards himself while watching the range poles). The marks are burnt in with hot iron. Three irons will do, which will burn marks as follows: 1″ = $\frac{1}{16}$″ — ⅜″ = $\frac{1}{16}$″ and one a half circle about ¼″ outer and $\frac{7}{16}$″ inner diameter. All numbers (Arabian are best) and other marks are nicely and quickly burned with these; they show well and do not wear. The middle of the number indicates the foot mark, the tenths are marked ⅜″ long and the half foot marks by a circle. Next we want three range-poles. They are made of well seasoned pine 4½″ = 2″ at bottom, 3″ = 1″ at the top, oval shaped, and are 12 ft. long, with substantial iron shoes at lower ends; they are painted alternately every 3 ft., bright red and white. For long distances light triangular frames (5 ft. sides) covered or stretched with red or white bunting, are screwed to the poles, point up on one and down on the other range-pole. Two black and white flags about a yard square, with light handles 4½ to 5 ft. long, are needed, one for the recorder (or leadsman) the other for the observer. The boat should be about 15 ft. long, be wide enough to be stiff, have a wide stern and little if any keel, so that it may be easily handled in quick water and especially in turning. A hatchet-saw, some stone drills and hammer, a small pointed crowbar, and a pot of red-lead paint and marking brush, completes the list of tools. For measuring base-lines we use a 200 ft. standard steel tape, for detail measurements a 50 ft. steel tape. A leveling instrument and rod, a couple of surveyor's poles and a telemeter, of course, are included in the outfit.

The advantages of this system of surveying will be still more apparent, when it comes to laying out work, especially for dredging operations.

After the location of the channel is decided upon and drawn upon the map, we can establish longitudinal ranges for guiding the dredging machines. The distance which these ranges are apart, depends upon the width the dredging machine can cut; as one set of ranges only is needed for two adjacent cuts (the port side of dredge being kept on the range for one cut, and the starboard side on the same range for the next cut), the distance between these ranges is twice the width of the cut the dredge can make. The daily progress of the dredge is exactly determined by side-ranges, crossing the channel at angles not less than 30°; these ranges are established from suitable triangulation stations, and generally the ranges formerly used for sounding can be re-established for this purpose. In cases where longitudinal ranges cannot be established on shore, guide-piles are driven at suitable places, and signals fastened to them. For curved channels and places where dense fogs prevail a good part of the time, we use piles driven about 200 feet apart, and about 10 to 15 feet from the edge of the channel; they are numbered to correspond with the plan. A fine wire rope (seven thread) is stretched from one pile to the other, and the dredge's bow—for the several cuts—is kept parallel to this wire rope by means of a marked line attached to this wire rope by means of a snatch block. Dredging can be minutely reported and followed up at headquarters as well as on board the dredge. The amounts dredged can be checked at any time by transferring the progress made on the estimate sheet, and then calculating the amounts contained in the areas dredged over. A so-called progress-sheet, showing all the longitudinal, as well as the side ranges, is kept on board the dredge. The progress for each day is marked on this, and, being reported to head-quarters, is there marked in the same way on a copy of that progress-sheet. The report states simply the number of the cut and the distance of bow of dredge above or below the respective side range. Much more could be said regarding small details; these, however, will suggest themselves. Trusting that these notes will give some acceptable hints to those about to make a hydrographic survey, I hope I have not encroached upon your valuable space too much already.

A NEW DRILL.

The drill of which the above is a cut, is manufactured by the Chicopee Machine Company, Chicopee, Mass. The length is 15 in. with ⅝ steel drill. The spindle has right and left double grooves with two right and left handed nuts to match the same. The outer edges of the nuts have ratchet teeth to clutch with corresponding teeth upon the inner faces of the slide, and these nuts thus enclosed be-



tween the ends have sufficient space left between them to enable one to be disengaged, while the other is clutched fast to the slide. So that, when the slide is moved, one nut becomes part of the slide to impart motion to the drill, while the other is free to follow within the slide upon the stem. So whichever way the slide is moved, the drill runs in the same direction. The drill was patented April 19, 1881. The chuck is made of steel and is a new device for which a patent has just been allowed. It holds a drill from $\frac{1}{32}$ to $\frac{1}{4}$ in., and can be used for either metal or wood.

SANITARY INSTITUTE OF GREAT BRITAIN.

The following were the papers set at the fall examination held by this Institute for surveyors and inspectors of nuisances. They will doubtless be of interest to many of our readers:—

Examination of Surveyors.

PAPER 1.—2 TO 4 P.M.

1. State the principal provisions of the Public Health Act of 1875. Is it applicable to the whole country? Has it been modified by subsequent legislation, and if so, how?

2. Give the substance of the model by-laws issued by the Local Government Board, regulating the construction and management of slaughter houses.

3. A 12-in. pipe sewer is running half full, and the sewage has a velocity of three feet per second; how many gallons will be discharged per minute? Also, how many gallons per minute will be discharged from a 6-in. pipe drain under the same conditions? Give your calculations in full.

4. Describe and give a sketch of the form of man-hole which you consider best adapted for ordinary town sewers, and state the rule which you adopt for determining the amount of ventilation to be afforded in a main street sewer.

5. Describe (with diagram) three typical forms of disconnecting traps for drains, and explain their action.

6. What are the chief points to be looked at in order to determine whether a water-closet is satisfactory from a sanitary point of view? Illustrate your answer by sketches.

PAPER 2.—6 TO 8 P.M.

1. What is an artesian well? Under what circumstances would you advise the construction of such a well?

2. How is drinking water most likely to become polluted—(*a*) in a town with a public water supply? or (*b*) in a rural district? What precautions would you take in each case to prevent the pollution?

3. What circumstances favor the entrance of "ground air" into a building? Why is it necessary to exclude it, and what are the principal modes of doing so?

4. Give a clear and concise definition of good ventilation, stating how much air is required per head per hour.

5. Sketch plan and section of a hospital ward and its offices for twelve patients and state how you would proprose to ventilate it.

6. Sketch sections of roadways constructed of different materials, and state the advantages and disadvantages of each.

Examination of Inspectors of Nuisances.

4 TO 6 P.M.

1. What diseases are considered infectious? What is the law with reference to the exposure of persons affected with infectious diseases.

2. What are the provisions of the Public Health Act of 1875 with regard to cellar dwellings?

3. Why is ventilation necessary? What is the greatest number of people that should be allowed to sleep in a dormitory 30ft. by 15ft. by 12ft high?

4. Under what cirumstances is it necessary to have butts or cisterns for the storage of drinking water, of what materials are they usually made, and in what ways may the water in them become contaminated?

5. What are the relative advantages of pipe and brick drains? What do you consider the least fall that a house drain should have?

6. What are the most important points to be observed in inspecting a cow shed?

7. You are sent for to a house where there is a case of small-pox. What steps would you take?

8. If you are refused entrance into premises where you have reason to believe that a nuisance exists, what would you do?—*Contract Journal.*

DISCREDITABLE DIPLOMACY.

[From the London Shipping and Merchant Gazette.]

The gigantic castrophe which has overwhelmed Alexandria, and consigned its Grand Square and most of its business quarters to the flames is a melancholy culmination of a long and rather discreditable diplomatic history. Arabi ought long ago to have been suppressed. The impotence of Europe, and the miserable jealousy of France in particular, prevented him from being put down, and the consequence is that he has ruined all the trade in Egypt and destroyed Alexandria. This is the result of modern diplomacy, and in the light of the flames of the chief port of Egypt we must say that we prefer the ancient kind which would have put an end before now to a man who could have been dealt with three months ago by a single regiment of soldiers. What he has done in Egypt is simply this—he has brought the whole State into a chaotic condition of anarchy. Since 1860 the crops have been trebled. European capital has redeemed vast tracts of waste land; it has furnished the natives with loans on easy terms; it has purchased steam pumping machinery for irrigating purposes; it has erected cotton-gin factories and steam presses, and it has established means of communication between the producer and the export ports. All this goodly edifice has been brought to the ground by Arabi. The producer can neither sell his goods nor pay his laborers. Since the commencement of the troubles usurious rates have been charged for loans. The steam machinery is useless, because its owners cannot buy coal. Mr. John Slagg points out that the cotton seed which was formerly burned in both houses and ovens, and even thrown away, is now exported to the value of £2,000,000 per annum. Ninety per cent. of it comes to England. In 1881 no less than 120,000 tons came to Hull alone, and 2,500 men and boys were employed in crushing it. The farmers who buy this cotton cake for feeding purposes will now be compelled to pay higher prices for the limited quantity reaching our markets, and a large number of people in this country will be thrown out of occupation. The soap boilers, who obtain 50,000 tons of oil from the same product, will also suffer. About 70 per cent. of the 1,000,000 quarters of wheat annually exported from Egypt comes to England, and so do about 30,000 tons of sugar. These and the 200,000,000 pounds weight of cotton which we annually obtain from the same source can no doubt be obtained elsewhere, but Egypt took in return for them manufactured goods, machinery, coal and cotton goods, and all of these interests must suffer more or less from the ruin which has overwhelmed Egypt.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST.....EDITOR AND PROPRIETOR.

S. D. V. BURR.....ASSOCIATE EDITOR.

SATURDAY, JULY 29, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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NOTICES OF MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.

COLORADO MEETING.

Programme.

Saturday, Aug. 19—In Denver. A brief preliminary evening meeting, at which the Institute will be received by the citizens of Denver.

Monday, Aug. 21—Visit to Black Hawk and Central, with an evening session at Central City.

Tuesday, Aug. 22—Georgetown. Idaho Springs. Return to Denver in the evening.

Wednesday, Aug. 23—Leadville, going over the South Park Railroad. Evening session.

Thursday, Aug. 24—Excursions to the Leadville mines.

Friday, Aug. 25—Excursions to the Leadville smelting works, reaching Pueblo at night.

Saturday, Aug. 26—Pueblo Iron and Steel Works, and Mather & Geist's Smelting Works. Colorado Springs and Manitou in the evening.

Sunday, Aug. 27—Colorado Springs and Manitou.

Monday, Aug. 28—Return to Denver. Evening reception.

Tuesday, Aug. 29—Argo Smelting Works. Golden and its smelting works. Subscription dinner.

Besides these excursions, facilities will be afforded those who desire to see the iron and coal mines of Colorado. And for those who can extend their visit, an excursion to the San Juan district will be organized.

Arrangements are being made with the railroad companies for reduced rates to members of the Institute and ladies accompanying them. When concluded, a circular will be issued informing members of the expenses from different points to Denver and return. These rates will probably not exceed two-thirds the regular rates, or about $60, plus Pullman car special rates, from New York to Denver and return. Special facilities are courteously offered by the roads in Colorado for the excursions of the Institute.

Persons proposed for membership have the same privileges as members with regard to the meeting and excursions.

As usual at the meetings of the Institute, ladies are expected to be present. Seventy-seven members with forty-three ladies have already signified their intention of being present at the Colorado Meeting, and it is expected that the attendance will greatly exceed these numbers.

The unusual attractions offered by the mining regions of Colorado are increased at this time by those of the Denver Exposition of mining appliances, minerals, etc., and by the unusual facilities offered for examining mines and works, and acquiring information concerning them.

The representatives of several foreign kindred societies are expected to be present.

Members who purpose attending this most interesting meeting should at once write the secretary of the Institute, who has to notify the railroad companies of the number of tickets required, and the names of those entitled to the special rates offered. They are also requested to inform the secretary promptly of their intention to read papers at the meeting.

Prof. W. I. Marshall, who is well known by his lectures on the wonders of the Geyser Country, offers to conduct a party of not less than eight, nor more than twenty-five, through the Yellowstone National Park. This trip would occupy from twenty-six to twenty-nine days from Denver to and through the Park and back to Denver. The greater part of this time would be spent "camping out" in the Park. The expenses of this round trip are estimated at from $275 to $300 for each person. Full information concerning this trip may be obtained from Prof. W. I. Marshall, Fitchburg, Mass.

R. P. ROTHWELL, President,
27 Park Place, New York City.

T. M. DROWN, Secretary,
Easton, Penn.

THE RIVER AND HARBOR APPROPRIATION bill, as amended by the last Committee on Conference and finally passed by both Houses of Congress, appropriates $18,743,875.

TORONTO, Canada, is expending a large amount of money this season on public improvements. Besides the street-paving noticed elsewhere, several sewers are in process of construction and more are being planned. They and all roadways are built on the frontage tax system. Laborers' wages are $1.25 to $1.50 per day; bricklayers get $2.75.

THE *North American Manufacturer*, of Philadelphia, commences its fourth volume, new series, under the new title of *Iron*. New talent has been engaged in the various departments of the paper, and the general typographical appearance much improved. There are 16 pages of wide three-column measure, containing able articles on pertinent subjects and full market reports from the leading manufacturing centres. We wish unbounded success for our contemporary.

In the June transactions of the American Society of Civil Engineers A. G. Menocal has a paper in Sub-Aqueous Underpinning, and R. E. McMath has a paper on The Mean Velocity of Streams Flowing in Natural Channels. Both papers are very fully illustrated. The additions to the Society membership published: are, Members; Wm. H. Bixby, Lieutenant of Engineers, U. S., Willets Point, N. Y.; Wm. G. Curtis, Superintendent of Track Central Pacific Railroad, San Francisco, Cal.; Thomas Doane, Consulting Engineer, Charlestown, Mass.; Edmund L. B. Gardiner, Engineer Dundee Water Power and Land Company, Passaic, N. J.; Edward H. Keating, City Engineer Halifax, N. S. Associate; Ashbel Welch, Jr., Proprietor Lambertville Iron Works, Lambertville, N. J. Junior; John R. Freeman, Prin. Assistant Engineer Essex Water Power Company, Lawrence, Mass.

CHEAP MOTIVE POWER.

Storage batteries and their great possibilities are turning attention to cheap motive power. A paper, by Alfred R. Wolff, M. E., on the economy of the wind-mill, was read before the American Society of Mechanical Engineers, April, 1882. This able article has been reproduced in the Journal of the Franklin Institute and in some other periodicals. In it Mr. Wolff asserts that the wind-mill "is the most economical prime-mover for the purposes for which it is designed." As other able engineers frequently state that wind is our cheapest motive power, it might serve a good purpose to show that they are in error.

Upon the Danube, the Adige and other swift rivers of Europe, hundreds of water-mills or current-motors are employed, and for purposes which the wind-mill is nowhere attempting. These current moters are much more economical than wind-mills *for any purpose*, for the simple reason that a good current of water is much more powerful than any current of wind that can be obtained. A man may be upset by the force of a bucket-full of water, but who was ever knocked down by a bucket-full of wind.

The pressure of a wind of 20 miles an hour is only 2 *lbs. to the square foot*, while a 5-mile current is 54 *lbs.* (the pressure in lbs. per sq. ft. = the square of the velocity in feet per second). Thus water at 5 miles per hour has 27 times the pressure, and will yield about 7 times the power of wind at 20 miles an hour (the wind having an advantage of 4 to 1 in velocity). But we must multiply 7 by 3, because the current runs 24 hours per day, while the wind only averages 8. But in point of fact this *average* 8 is to most users worth less than a *regular* 4 hours—for reasons unnecessary to enumerate.

It is hard to believe, but easy to prove, that there are many points in the United States where current-motors would produce from 10 to 40 times the power of the most favorably-located wind-mill of the same size. There are many towns on swift streams which could quickly double their population and the value of their property by utilizing for manufacturing purposes the river rolling at their feet. These are enormous facts which should receive attention.

Wind is an idle, wanton worker, who demands many playdays and much sleep. He is a servant whose efforts constantly vary from nothing to too much. Much of the time he will not work at all; then, to make up for lost time, he works "like a house a'fire" (*à outrance*), or breaks his machine into fragments and hurls them at his master.

Still, wind-mills are coming more and more into use. We do not disparage them. We do not esteem wind-mills less, but current-motors more. If the feeble and variable force of the wind can be so profitably employed,* how much more can a powerful stream which *flows regularly night and day and in an unvarying direction.*

'Tis true that the *locality of use* is more restricted with current-motors (and this has operated against their being more generally known), but there are thousands of miles of river shore where they will furnish power at one-half to one-tenth the cost of steam. After one or two current-motors are placed in such rivers as the St. Clair, power-users in the United States will awaken to their value. In the St. Clair there is, for several miles, a current of six to seven miles per hour. This is a force equal to the hurricane that uproots large trees.

Much swifter currents are found at many rapids. In high water many parts of the Mississippi and hundreds of miles of the Missouri have a current of 7 miles an hour.

This represents a pressure of 940 *lbs. to the square yard.* A current motor with 40 sq. yds of paddles or suitably braced sails, exposed to the action of such a current, would yield 180 horse power, and, working 24 hrs., would equal 432 *horse power* 10 *hrs. a day.*

$$\frac{K.\ P.\ A.\ V^3}{2g \times 75} = \text{the horse power.}$$

$K = 3.$

P, the weight of a cubic metre of water (1,000 kilograms).

A, the area, in square metres, of surface exposed to the action of the current.

V, velocity in metres per second.

g, gravity (9.8).

75, the number of kilogrammetres in a horse power.

Current-motors require no dam, canal nor tail-race.

On swift streams power can be obtained from current-motors at much less cost than by building dams; but grant all that dam-builders claim, and we still find that most of the water power of this country must be utilized by current-motors, *if used at all*, for two reasons:

1st. On most important streams dams are not permitted.

2d. On the rivers where permitted there are few places where sufficient power is desired in one locality to justify the cost of a dam. In other words, *there are few localities that are worth a dam.* Experience has proven the uncertainty of renting the surplus power, and *not $\frac{1}{500}$ part of the power of the rivers of this country is utilized by dams.* There are millions of horse-power in the Mississippi alone. *There is only one way to get it out* (after it has passed the falls of St. Anthony), *and that is by current-motors.*

Columbus, Kentucky, for instance, might need 1,000 horse-power, but they could not afford to pay $5,000,000 for a dam across the Mississippi, even were it possible for them to raise such a sum, and were a dam permitted.

Dam builders say, "You must have a fall." True, and the bed of a stream is a continuous fall—"w(h)at-er fall is there, my countrymen!"

It is unfortunate that the few current-motors that have been used in this country have been

* In Holland and Belgium wind-mills have performed herculean tasks—driving back the ocean and making his former bed to "blossom like the rose." There are thousands of places where wind-mills are not used, where great economy could be effected by their employment.

placed in slow streams. Seeing only five horse-power from a wheel in a current of two miles per hour, power users naturally supposed they would only get 10, or at most 20, in a four-mile current, whereas they would, in a current of four miles an hour, have a yield of 40 horse-power from the same size machine (the power of a running stream, for any given area of transverse section, increasing as the cubes of the velocities). Thus it is that a motor, which might be a nuisance in a slow current, may effect surprising economy in a swift one. An increase of velocity of the current can, in small rivers, generally be cheaply obtained by wings of rip-rap or piles.

With the wind-mill in successful and extensive use, to ignore the possibilities of the current-motor is to deny the difference of pressure between wind and water.

Their disadvantages are more imaginary than real but like the steam engine and all other motors they have disadvantages. In some rivers they must be protected from drift, and in the North from floating ice. This protection, when ice is not too heavy, is secured by strings of floating spars (booms), placed around them. During heavy running ice they must be beached, harbored or scuttled, but they work in a frozen river. They don't blow up nor burn down. If sunken they may rise again.

Even with three months annual loss of time their employment as auxiliary to steam (using the current-motor nine months of the year) effects great saving. In fact the saving over steam in one year's use would, in some localities, pay the cost of the current-motor.

Current-motors do not interfere with navigation. They are not placed directly in the channel. A river deep enough for navigation is wide enough for both steamboats and current-motors.

An intelligent use of the power of currents for manufacturing, farming, etc., would produce results, which, if stated now, would seem to fanciful for belief. It is the cheapest power there is, and the most abundant. It would occupy the whole human race 500 years to raise the quantity of water daily drawn from the sea by the sun and precipitated upon the earth.

Thompson, in "The Land and the Book" referring to the common rude current-wheel says: "This system of water-wheels is seen on a grand scale all along the Orontes. There is probably no hydraulic machinery in the world by which so much water is raised to so great an elevation at so small expense." A large part of the manufacturing of Verona—one of the principal manufacturing cities of Italy—is now done by current-motors, the river, at places, being literally filled with them.

Current-motors are placed one after another, as the current soon regains its velocity, while *water at a fall can be used but once.* On the river Adige 160 mills and factories are operated by current-motors.

The coming man will put the current to hundreds of different uses, and the time will come (on swift streams at least) when the current running down will propel the vessel up, and at a higher rate of speed than is profitable by steam. Current-motors will supply compressed air or storage batteries, for propulsion. All the inventions necessary to the success of such navigation are already made, and only await the "live man" to rise up and apply them. He may come to-morrow; he may not come for 50 years; but he will come. Fire and explosion are most disastrous on water. Removing these dangers, and heat and smoke, increases travel and reduces insurance. It will at first seem queer to see boats skimming along without smoke-stack or steam—as queer as to see a boat without a profane mate.

Current-motors could furnish electric light to a town at night and pump their water by day. They are very valuable to farmers near streams. The same motor that does any kind of work during the day will irrigate at night. A small motor irrigates a large tract of land. Few appreciate the importance and profit of irrigation. No droughts feared. Crops often quadrupled. *All* soils are productive when properly irrigated.

The farms or factory using water power need not be upon the banks of a stream. Power may be and already is in many places transmitted "over the hills and far away." Three miles for wire ropes is the maximum profitable distance fixed by high authority, Roebling Bros. Hirm Brothers claim 10 or 12 miles will, in some cases, pay. Fifty horse power may, at a velocity of a mile a minute, be transmitted with a wire rope the diameter of a lady's finger, while it is claimed by high electric authority (Sir Wm. Thompson and others) that water power may, with electric wires, be profitably conveyed "50 miles from its source."

Steam grows dearer as fuel, engineer and stoker advance in cost. The rivers carry to the sea 900,000 cubic miles of water annually; raised by the sun it hurries back to re-descend in rain; man has watched it for a hundred centuries resistlessly rolling past his door; Nature has waited a hundred centuries for man to utilize its ceaseless flow.

"Om mani padme hom, the sunrise comes
The dewdrop slips into the shining sea"—

in the rivers rolling to the sea are millions of horse-power daily running to waste. We do not appreciate the brook and river because they are so near and have been there so long. Had they commenced flowing but to-day we would hasten to harness them.

The running stream is an endless driving-band reeled out by Nature from the hollow of her hand; current-motors placed in gear with it revolve till worn away; they enslave the giant of the rolling river, chain him to their tasks, and make of him a patient drudge as long as waters flow; he works days without murmur, nights without sleep and Sundays without sin, with Nature for his only driver.

THE KINZUA VIADUCT.

In a note copied from the New York *Sun* last week into this journal, it was stated that $8 was being offered for men to work on that structure. From the contractors, Messrs. Clarke, Reeves & Co., we learn that the statement is not correct. They say: "We pay foremen on that work five dollars to six dollars per day; other workmen from two dollars to three dollars per day. These men are nearly all our old bridge erectors; they are satisfied with their pay and not afraid to go up 300 feet; in fact they wish the structure was twice as high. One hundred men are now working as erectors. The structure is more than one-half erected, and will be completed by September 1, 1882. Thus far only one man has been hurt, but he is now at work again. The viaduct is being erected *without the use of a single ladder, plank or any staging whatever.* The men go up and down on the longitudinal and transverse rods, and do all the work of connecting, screwing up and adjusting, by standing or sitting upon the transverse and longitudinal struts, which are 12 inches wide. The viaduct trestle is constructed in such a manner as to require no riveting, chipping, filing or fitting of any kind. This far not a chisel has been used in erecting."

WANTED.—A SUPERINTENDENT OF WATER-WORKS.

The following advertisement appears in a Pittsburgh official paper:

OFFICE OF CITY CONTROLLER,
PITTSBURGH, July 15, 1882.

TO MECHANICAL ENGINEERS — UNDER the provisions of an ordinance relating to the office of Superintendent of Water-Works, and fixing the salary of same, the Water Committee invite applications from mechanical engineers. All applications must be filed with the Controller until August 4, 1882. All applications must be accompanied by certificates and proofs as to the applicant's competency as a skilled mechanical engineer. The salary of the Superintendent is four thousand dollars per annum.

E. S. MORROW, Controller.

The Pittsburgh water-works have been a by-word for many years, for bad management. It has been a wonder to every one outside of that city that in a place which abounds in business men of extraordinary capacity for management of affairs, full of firms which control great enterprises, reaching out to all parts of the country, a great municipal work should be managed with such utter disregard of business principles. And now they go from bad to worse. It is difficult to conceive of a worse method of procuring a good and efficient superintendent of water-works than the one adopted by the city council according to the above advertisement. We doubt if a single really competent man for the position will put himself up for competition under the terms of this call. Think of such men as Davis, Hermany, or Whitman answering such an advertisement. But that is the kind of men they want in Pittsburgh. Not a mere engine driver or machinist but a trained and experienced civil engineer who knows what is wanted and can carry it out even if he is not able to bring testimonials of his ability to plane a joint or chip a casting.

NEW PUBLICATIONS.

The Proceedings of the Engineers' Club of Philadelphia for June is received. It is perhaps the most valuable of all the many valuable contributions to engineering literature that have been given to the profession by this enterprising society. The contents are: A Personal Sketch of Lewis M. Haupt, Past President of the Club, illustrated; Application of Logarithms to Problems in Gearing, by Wilfred Lewis; The Working Strength of Bridge Posts, by Geo. P. Bland; What Thickness of Metal Should be Given to Cast Iron Water Pipes Under Pressure, by P. H. Baermann, illustrated by four folding plates; Resistance to Traction on Roads, by Rudolph Hering; Philadelphia & Long Branch Railway, by C. S. d'Invilliers; Brick Work Under Water Pressure, by D. McN. Stauffer; On the Strength of Wrought Iron Columns, by T. S. Cleeman; Expansion of Iron Embedded in Brick Work, illustrated; Mechanical Boiler Cleaner; Auchincloss' Averaging Machine. The Proceedings are edited by the Secretary, Howard Murphy, and copies are for sale (although we do not speak by authority on this point) at 1523 Chestnut street, Philadelphia.

The contents of the *Journal of the Franklin Institute* for August are: On a Theorem of Rankine Relating to the Economy of Single Acting Expansion Engines, first published in 1851, by Prof. W. P. Trowbrige; The Specific Heat of Platinum, and the Use of this Metal in the Pyrometer, by J. C. Hoadley; Bell Chimes in Philadelphia and other Places, by John W. Nystrom; Electric Clocks and Time Telegraphs, by Louis H. Spellier; Feldspar as a Source of Potash Alum, by John Spiller; On the Prevention of Fires in Theatres, by C. John Hexamer; The Pollution of the Schuylkill River, Report; Recent Improvements in the Mechanic Arts.

The North American Review for August is an especially excellent number of that excellent magazine. Rev. H. W. Beecher discourses on the Progress of Thought in the Church. He says, among other things:

"The development of physical science constitutes the grand feature of the last half century. The doctrine of the *Conservation of Forces* and the discovery of the method of creation, viz.: *Evolution*, while revolutionizing physical science, will powerfully reform social and moral theories. At length the flood of ignorance has abated, and the dove of truth has solid ground on which to put its foot. The study of the human mind from the side of physics as well as metaphysics is productive of changes of the most radical and important kind. Religion has much to hope, and the old theology much to fear from scientific disclosures."

T. V. Powderly has an article on The Organization of Labor, in which the relations of labor and capital, strikes, etc., are discussed. Archibald Forbes, the great war correspondent, writes some interesting things about the United States Army; Woman's Work and Wages, by Chas. W. Elliott; The Ethics of Gambling, by O. B. Frothingham; The Remuneration of Public Servants, by Frank D. Y. Carpenter, are all very readable and very useful information; Dr. C. A. White has an article on Artesian Wells upon the Great Plains,

in which he shows from the geological structure of the country the uncertainty of such a source of water supply and the unavailability of it on account of the great cost of sinking such wells. The *Review* is not light magazine reading, but it is a very useful publication. The office is 30 Lafayette Place, N. Y. city, and the price is five dollars per year.

PERSONAL.

C. M. KENDALL is superintendent and chief engineer of the Denver Circle railroad; offices in Denver, Col.

PRESIDENT ARTHUR has sent the following nominations to the Senate: Captains WILLIAM LUDLOW and WILLIAM A. JONES, Corps of Engineers, to be Majors.

R. FRENCH, for several years roadmaster of the Mahoning division of the New York, Pennsylvania & Ohio has been appointed chief engineer of the Cleveland, Mt. Vernon & Columbus road.

F. C. HAND has been appointed Chief Engineer of the California Short Line Railroad Company, lately organized; offices, Salt Lake City. The purpose is to build from Salina, on the Sevier river, to Springville, where connection will be made with the Denver & Rio Grande. The locations have been made, and it is expected notice of letting work will be given within the next thirty days.

MR. ROBERT BRIGGS, a well-known civil and mechanical engineer, of Philadelphia, died at his mother's residence, in Dedham, Mass., July 24, after a lingering and painful illness. Mr. BRIGGS was born in Boston, May 18, 1822, and was educated in the Boston schools, pursuing his professional studies under Capt. ALEXANDER PARRIS, an engineer and architect, of Boston. He spent much of his life in Washington and Philadelphia. He was employed as engineer under Gen. MEIGS in the extension of the National Capitol and in the construction of the Washington Acqueduct. He was afterward superintendent of the Morris & Tasker Iron Works, at Philadelphia, and subsequently associated with HENRY G. MORRIS, in the Southwark Foundry. The large pumping-engine of the Lowell water-works was built under his direction. Of late years he has been employed as a consulting engineer, and, up to the time of his last illness, he held that position in the United States Engineer's office, in Philadelphia. Mr. BRIGGS was for a time the editor of the *Journal of the Franklin Institute*, and was a member of several associations of architects and engineers in this country. He had also the honor of being elected, some years ago, a member of both the institutions of civil engineers and of mechanical engineers in London.

THOMAS GUARDIA, who has presided over the destinies of the Republic of Costa Rica for nearly twelve years, died on the 7th inst. Personally President GUARDIA was an ignorant, unlettered man, whose idea, so far as society was concerned, was to present the greatest display possible. He was no politician, and through his whole career in the republic gave no evidence of his skill in that regard, except by a few decrees, which will die with him. He had the crudest ideas of finance, and plunged his country into an abyss of debt, from which it will not recover for many years. He wished to associate his name with some great national work, and the idea of an interoceanic railroad captivated his imagination. He commenced it, but began the work of grading and track-laying in the center of the country instead of on the shore. As may be supposed, every rail cost a small fortune, and two locomotives, which were imported to begin the work, cost for land transportation alone $30,000 each. Such extravagance naturally brought with it a result which everybody expected. The millions which the bondholders furnished were dissipated; spent without reason or purpose, until nothing remained. But still GUARDIA clung to the idea of a railroad, and for five years spent every cent of revenue he could divert to the purpose to the prolongation of the railroad. To-day Costa Rica is ruined in credit, and every resource is pledged in one way or another to the ideas of the late President. The millions GUARDIA spent have simply given the country a few miles of railroad, divided into three sections, and which will never be of positive benefit until they are connected.

MR. ARTHUR GILMAN, a well-known architect, died in Syracuse, N. Y., on the 11th inst. He was born in Newburyport, Mass., and was a graduate of Trinity College, Hartford. Becoming deeply interested in architecture, he published in the *North American Review* for April, 1844, a paper on "American Architecture," which at once attracted wide-spread attention. It was copied in Europe, and translated into several foreign languages, and on the strength of it Mr. GILMAN was appointed to deliver a course of twelve lectures on that subject before the Lowell Institute at Boston. After delivering these lectures Mr. GILMAN went to Europe on a tour of professional observation, and passed some time in study and travel abroad, receiving much civility and attention from Sir CHARLES COCKERELL at that time the President of the British Institute of Architects, from Prof. DONALDSON, the Foreign Secretary of that same body, and especially from Sir CHARLES BARRY, the distinguished architect of the Houses of Parliament. To the friendship of Sir CHARLES BARRY Mr. GILMAN was indebted for many opportunities of seeing all that was best and most valuable in the architecture of England. He visited and studied all the finest English cathedrals. This experience confirmed his faith in the principles and his love for the forms of the Anglo-Norman and German schools in architecture. Nor did he neglect the literary opportunities of his tour. THACKERAY, with whom Mr. GILMAN had become acquainted in America, entertained him most hospitably, and introduced him to the Garrick and Fielding clubs, where, as a "king of Raconteurs," to use THACKERAY'S words, he was welcomed and admired by men like CHARLES READE, TOM TAYLOR, MARK LEMON, ALBERT SMITH—then in the height of his "Mont Blanc" success—JOHN LEECH, the gifted artist of *Punch*, and the incomparable THACKERAY himself. Mr. GILMAN, before his return to Boston, matured a plan designed by himself for filling in and improving the "Back Bay" territory, then lying waste. He urged the plan upon the city government and the public with speech and pen for years, before the Legislature and elsewhere, and at last had the satisfaction of seeing his views carried out by the State of Massachusetts. From these improvements the Commonwealth has realized millions of dollars, "with more to come," and a new and elegant quarter has been added to the city. "Commonwealth avenue," which owes its width and extent almost entirely to Mr. GILMAN'S persistent efforts, has already become one of the finest streets in the world. He built the Boston City Hall, which is perhaps his best work, and he designed for the late Mr. CRANSTON a superb hotel, which if constructed would have been the finest in America. In 1865 Mr. GILMAN removed to New York, where, by his distinguished ability, his facile pen, his ready command of language, and his fine and scholarly tastes, he soon won hosts of appreciative friends. He was a member of the Union and New York clubs, and for many years of the American Institute of Architecture. He leaves a widow and one son twelve years of age.

RECENT INVENTIONS.

STATIONARY WASHSTAND AND FIXTURES.

This improved stationary washstand comprises a supporting slab and a basin provided with outlet and overflow openings. It is also provided with an inlet opening in the wall of the basin, and a valve constructed to allow the flow of hot or of cold, or of hot and cold water mixed, the valve being supported by the slab and below the same, and provided with a stem or key projecting through the slab, but flush with the upper surface thereof, so arranged as to leave the top of the stand free from obstructions of any kind.

PROCESS OF UTILIZING THE PRODUCTS OF COMBUSTION.

This improved method consists in utilizing all the heat arising from the combustion of fuel, and eliminating the injurious products. The heat generating devices are connected with a sewer or other main, and the injurious products forced through such sewer or main away from the inhabitants by positive mechanical means, and through a series of heat-utilizing devices, such mechanical means being employed in connection with a chimney or with the sewer or main.

IMPROVED SEWER AND MEANS FOR DISCHARGING SEWAGE.

In this invention the sewer system of a city is divided into working sections, each section being provided as to its main and branches with graduated air inlets, and near its discharge point with an exhaust mechanism, for the purpose of drawing in fresh air at the inlets and expelling the sewer air at the discharge, and with a velocity to materially expedite the discharge of the sewage, drive through an obstruction, and effectually ventilate the system.

NOVEL GAS MACHINE.

In this improved gas machine the carbureting pans or chambers are provided with double overflow tubes, having openings near the bottom of the outer shell or tube, and also openings near the top of the inner shell or tube, whereby the heavier oil is passed from the bottom of one pan to the pan below to the bottom chamber. Air to be carbureted enters first the bottom chamber containing the heaviest oil, and ascends through the overflow tubes, coming in contact with the lighter oil at the top chamber, in order that both heavy and light oil may be vaporized and carried off more uniformly by the air.

WASHINGTON, D. C. F. B. BROCK.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES M. AM. SOC. C. E.

(*Continued from page* 251.)

CCCLXI.—SOUTH NORWALK.

South Norwalk, Connecticut, in lat. 41° 7′ N., long. 73° 24′ W., is on rolling ground on the shore of Long Island Sound, at the mouth of the Norwalk River. It was settled in 1649.

Water-works were built by the town in 1875, after plans of William B. Rider, taking the supply from a stream 5 miles from the city, impounded in two reservoirs, which contain 166,000,000 gallons, and are formed by earthen dams, with rubble masonry heart walls laid in cement. The watershed is about 5 square miles. The reservoir is 223 ft. above the city. At the outlet the water is filtered through charcoal and sponge, and is then conveyed to the city through 4¾ miles of 12-in. cast-iron pipe.

Distribution is by 9 miles of cast-iron pipes of from 2 to 4 in. diameter, with 58 fire hydrants and 65 gates. The number of taps is not furnished. One meter is in use. The city formerly paid $25 per annum for each hydrant, but now the receipts from water rates exceed the expenses. Lead, iron and brass are used for service pipes. The population in 1880 was 5,300. The daily consumption is not given.

The works cost $100,000. Further financial statistics are not furnished, except that the revenue is now 2½ per cent. in excess of cost of maintenance and interest on debt.

The works are managed by three water commissioners, elected for three years. W. B. Rider is the engineer.

CCCLXII.—GOSHEN, Y. N.

Goshen, New York, in lat. 41° 2′ N., long. 74° 8′ W. is in a hilly region, about 20 miles west of the Hudson river.

Settled in 1714. it was incorporated as a village in 1809, and re-incorporated in 1843 and 1873.

Water-works were built in 1871 by the city, under superintendence of C. Colwell, taking the supply from springs and a small stream about a mile from the town which is impounded by an earth dam 37 ft. high and 266 ft. long, 12 ft. wide on top. The area of the reservoir is twenty-three acres, and its water shed 250 acres. It contains 46,000,000 gallons, 120 ft. above the city, to which the water is conveyed in a 12 in. wrought-iron and cement pipe, and distributed by six and a half miles of the same pipe, of 10 to 4 in. diameter;

with 46 fire hydrants, 17 gates and 231 taps. Lead service pipes are used.

The population in 1880 was 2,546. The consumption is not given.

The works cost $60,000. The bonded debt is $35,000 at five to seven per cent. interest.

The expenses in 1881, were $2,600 including interest, and the receipts were $2,600.

T. D. Tuthill is the Water Commissioner and Superintendent.

CCCLXIII.—WACO, TEXAS.

Waco, Texas, in lat. 31° 22′ N., long. 97° 4′ W., is on the Brazos River, on ground rising from the west bank to the river, to an elevation of 130 ft. in 1½ mile.

Settled in 1830, it was incorporated as a city in 1858.

Water-works were built in 1878 by C. W. White, for a private company. The supply is taken from a well 16 ft. in diameter and 42 ft. deep, the lower 12 ft. being through coarse water-bearing gravel. The water is pumped 105 ft. by a Knowles steam pump into wooden tanks holding 100,000 gallons. The pressure is obtained by pumping directly into the mains.

Distribution is by 9 miles of cast iron pipe of from 12 to 3 in. diameter, with 35 fire hydrants, 12 gates and 536 taps. There are 70 meters in use. The city pays $2,800 per year for fire hydrants. Service pipes are of wrought iron.

The population in 1880 was 7,317. The daily consumption varies from 150,000 gallons in winter to 350,000 gallons in summer.

The capital stock of the company is $100,000. The works have cost $80,000. The bonded debt is $10,000 at 10 per cent. and $40,000 at 7 per cent. interest. The expenses in 1881 were $4,000 and the receipts $12,000.

C. W. White is President and James E. Eagen the superintendent and secretary.

CCCLXIV.—PARK CITY.

Park City, Utah, in lat. 40° 45′ N., long. 112° W., on Silver Creek, lies at the mouth of a gulch or cañon in the foot hills of the Wahsatch range of mountains. The site rises steeply from the stream each way.

Settled as a mining camp in 1870 it was laid out in plats in 1876, but has not been incorporated.

Water-works were built by a private company in 1880 after plans of W. M. Ferry, taking the supply from a mountain stream a mile from the town. Three dams of stone form three successive reservoirs, of an average depth of 12 ft. and aggregate capacity of 1,000,000 gallons. The water, when the upper reservoir is full, falls over the dam 12 ft. to the next one, and in like manner over the second dam. From the lower reservoir it is drawn to the city. The dam is of dry stone masonry, founded on brush and filled in on each side with coarse gravel.

The two upper reservoirs can be cleared out through a tight box flume passing under the two lower dams without disturbing the water in the lower reservoir. In 1881 a "cloud burst" from the mountains filled the two upper reservoirs with débris, which was flushed out in one day through this flume. The reservoir is 200 ft. above the town.

Distribution is by Horton's wood pipe, made of Oregon pine, spirally banded with iron. It is of 8-in., 6-in., 3-in. and 2-in. diameters. Some of the pipe first laid was badly manufactured and had to be replaced. The length of pipe laid is not given, nor the number of taps. There are six fire hydrants and 12 gates. The town does not pay for use of hydrants. Galvanized iron service-pipes are used. The population in 1880 was 1,500, and is now about 3,000. The daily consumption is not given. The capital stock of the company is $20,000. The works cost $19,000. There is no debt. No further financial statements are given, but they are promised at the end of the year.

William M. Ferry is the Superintendent, and Thomas Cupit, Secretary.

CCCLXV.—DUTCH FLAT.

Dutch Flat, California, in lat. 39° N., long. 121° W., is on a ridge between the Bear and American rivers, 3,400 ft. above the sea.

It was settled in 1846.

Water-works were built in 1859 by private enterprise.

The supply is taken from springs and miners' ditches, and collected in a reservoir in embankment, lined with wood, 40x60 ft. square and 8 ft. deep, at 200 ft. above the town. The pipes are from 13 to 6 in. diameter of sheet-iron, coated with asphalt, and of cast-iron, and there are also used in the distribution logs of 2-in. bore, lead-pipe and plain and galvanized wrought-iron pipe of 2 in. to ¾-in. diameter. There are laid 1½ miles, with 10 fire hydrants and 200 taps.

The town contributed $2,500 towards the construction of the works, and the proprietor guaranteed the supply and free water for fires. Wrought-iron service pipes are used.

The population in 1880 was 1,185. The consumption cannot be correctly estimated.

The works have cost $5,000, and the receipts have been $3,600. There is no debt.

The expenses in 1881 were $700, and the receipts $1,400.

The works have been owned and managed since 1865 by Isaac Tibbitts Coffin.

CCCLXVI.—NEW CARLISLE, IND.

New Carlisle, Indiana, is in lat. 41° 44′ N., long. 86° 32′ W. The town was settled in 1840. Water-works were built by the village in 1878 after plans of George C. Morgan, taking the supply from a well 10 ft. in diameter and 35 ft. deep. The water level is 23 ft. below the surface of the ground. There are four 2½-in. pipes driven in the bottom of the well. The water is pumped by a Worthington duplex engine, with 7-in. pump bore, to a height of 92 ft. into a tank 18 by 22 ft. and 25 ft. high. In case of fire water is pumped directly into the mains under 100 lbs. pressure.

Distribution is by ⅞ mile of 6-in. and 4-in. Wyckoff wooden pipe, with 13 fire hydrants and 2 gates. The number of taps is not given. Service pipes are of galvanized iron.

The population in 1880 was 5,500. The daily consumption is not given.

The works cost $7,000. There is a bonded debt of $5,000 at 7 per cent. interest.

Further financial statements are not furnished.

The works are managed by a board of three commissioners. F. D. Warren is the Treasurer and W. H. Wade the Superintendent.

CCCLXVII.—WINNEMUCCA.

Winnemucca, Nevada, in lat. 40° 58′, 20″ N. long., 117° 43′ 54″ W. is in the mining district, along the line of the Central Pacific Railroad.

The town was settled about 1870.

Water-works were built by a private company in 1877 after the plans of J. Culver, taking the supply from Cross Cañon in the Harmony Mountains, and conveying the water by a 7 in. wrought iron pipe to a small reservoir 125 ft. above the town. A storage reservoir is now building in the cañon, 100 ft. square and 16 ft. deep at 950 ft. above the town.

Distribution is by 5 miles of 5-in. wrought iron pipe, with 10 fire hydrants and 100 taps.

The population is now 800, and the average daily consumption 250,000 gallons. In August and September the consumption is about equal to the supply.

The works cost originally $16,000, and $12,000 has since been expended in reconstruction. J. B. Gramm is the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics, as follows, is acknowledged with thanks: From William M. Terry, Superintendent, statistics and water rates of the water-works of Park City, Utah. From T. D. Tuthill, Treasurer and Superintendent, statistics and water rates of the water-works of Goshen, N. Y. From W. B. Rider, Engineer, statistics of the water-works of South Norwalk, Conn. From Isaac Tibbitts Coffin, statistics of the water-works of Dutch Flat, Cal. From George A. King, C. E., annual report of the water-works of Taunton for 1880. From C. W. White, President, statistics and water rates of the water-works of Waco, Texas. From F. D. Warner, Treasurer, statistics of the water-works of New Carlisle, Ind. From Eugene Ricksecker, U. S. Geol. Survey, statistics of the water-works of Winnemucca, Nevada. From R. J. Braugh, City Engineer, reports for 1881.

CORRECTION.—July 22, 1882, p. 251.—*Palestine.*—End of second paragraph, for "*steam* pipes" read "steam pumps."

Brookline.—Near end of third paragraph, for "great discoloration" read "peaty discoloration." End of fourth paragraph, for "sands" read "sand." Beginning of fifth paragraph, for "Washington" read "Worthington."

THE SUEZ CANAL AND PORT SAID.

THE IMPORTANCE OF THE GREAT HIGHWAY BETWEEN EUROPE AND THE EAST.

The telegram from Suez apprising us that up to yesterday morning no vessel had been permitted to enter the canal for 48 hours past brings more vividly before our minds the importance of that great highway between Europe and the East than anything that has happened since the grand ceremony of the opening in 1869. To our commerce this barrier to the progress of vessels, both homeward and outward bound, is, we need hardly say, of far more importance than to that of any other nation. So that, at least, it cannot be said that Admiral Seymour's precautionary order has inflicted on our neighbors any inconveniences which have not been shared, and in far greater degree, by the English seafaring and mercantile world. The figures speak for themselves. The great work of M. de Lesseps, as we all know, was not due in its inception to English enterprise, nor did it, we must with sorrow confess, receive much encouragement from English statesmen of any party, but it was yet predestined to be essentially the great route for our vessels, and from the first British commerce through the canal has necessarily overshadowed that of every other nation. Last year no fewer than 2,728 vessels passed through, of which all but 471 were British, representing nearly 3,500,000 net tons, only 72,000 tons of which were Government shipping. Thus 82 in 100 of all these vessels carried the British flag, representing 83 per cent. of the entire traffic. The rapidity with which the habit of using the canal by vessels trading between Europe and the East has increased is still more striking. In 1870, the year after the opening, there were only 486 ships, with a gross tonnage of 436,000 tons. Five years later the number had risen more than four-fold, and their tonnage nearly six-fold. The temporary damming up of this stream of commerce concentrates attention for the moment on the entrances, which, in a certain sense, were the crowning triumphs of the labors of the French engineers. Some account of Port Said and Suez, therefore, by way of refreshing the memory of readers, may here be of interest. Port Said, we may premise, is distant by sea from Alexandria about 140 miles. The port is purely the recent creation of human ingenuity and labor; and the town which has sprung up behind it, though numbering now at least 10,000 inhabitants, is not less the creation of the port. As M. le Masson, the French engineer, observed, it is a port "*contre nature.*" We may add, it is one that but for man's attention and care must in the course of no great length of time cease again to exist. Perhaps these facts may go some way toward palliating the mistake of the prophets who were wont to confront the projector with the difficulty of the "entrances." Given the canal itself, what, after all, is a canal without a way of getting into and out of it? This was the question which pressed most heavily on the minds of those who were responsible for the enterprise in the days when the great problem of ways and means was suggesting ingenious schemes and complicated transactions, while a writer in the *Edinburgh Review* had emphatically assured the public that "any construction attempted so as to form an entrance for the canal will be swallowed up," and that "not a single stone would be left above water." At this Mediterranean extremity, indeed, the prospect might well have daunted the heart of the most courageous of projectors. The problem was to get depth upon a comparatively shallow sandy coast, and this was practically attained by commencing the work on a sand-bank 26 miles from the main land. This long bank or belt of sand, extending from the mouth of the Damietta branch of the Nile to the Gulf of Pelusium, is described in Mr. Wyld's map as being of fine gray sand, five feet only above low water mark, and varying from 109 to 164 yards in width. Behind this irregular barrier is the shallow lake of Menzaleh, through which it was, of course, necessary to make an artificial channel for the canal. The first thing to be accomplished, however, was to construct the foundations for the future town to be named after the then Viceroy, and then to project into the sea the two enormous breakwaters or moles which form the outer port and protect it against that constant tendency to the accumulation of sand which, even as it is, demands constant dredging. The spot chosen on the sand-bank, or strip of what is locally known as "slob," is described as little more than 500 feet wide. The plan of the engineers was simple. At first a light framing of piles was run out on which a crane and trucks laden with loose stones traveled and in a short time a fairly substantial pier that served as a landing stage for materials and machinery was constructed. Here was, in fact, the great workshop of the undertaking throughout the ten years of its construction. Encouraged by this success (says Mr. Fitzg-raid) a bolder work was ventured on. Out in the bay, at nearly a mile distant, huge piles were screwed into the sands, and an oblong island was then formed with stones, the space between this island and the wooden shore pier being gradually filled in. Every day the piles settled firmly in their places, in spite of the storms of the bay. This temporary structure was carried out to a distance of about 300 feet, and it was not till three years before the canal was complete and ready for opening that the work was seriously resumed, and the breakwater joined to the pier. Two officers employed by the British government to examine the port describe it as formed by two rough, narrow, and low breakwaters, inclosing an area of some 450 acres, with an average depth of only 13 or 14 feet of water, except in the ship channel (about 300 feet wide) leading to the inner basins, where the depth is from 25 to 28 feet. The western breakwater, which extends for 6,940 feet at right angles to the shore, and is slightly curved eastward towards its extremity, was commenced in 1860, and carried out about 1,300 feet, beyond which point, and at a distance from it, was deposited a heap of stones that was surrounded by iron piles, and from its detached position was called "the island." The work was then left untouched till 1866, when the

breakwater was joined to the island, and it was continued to its present length and finished in 1868. From the mainland to the island the breakwater is formed on its inner side of a bank of rubble stones, surmounted by a promenade, over which the spray breaks with a very moderate north-west wind, and on the outer or sea front of concrete blocks, but beyond the island to its termination it is entirely constructed of large blocks of artificial stone, composed of one part of French hydraulic lime with two parts of sand, and some of which were transferred to it from the eastern breakwater. This latter, which is also constructed of large masses of concrete, is of more recent construction, extending to about 6,020 feet, and converging toward the western harbor. Such is the harbor of Port Said. It cannot, according to these authorities, be considered as a harbor either in respect of extent or depth for vessels of large tonnage and great draught; but, slightly improved and well maintained, it has, as we have seen, nobly served its purpose. Near the commencement of the West Mole is the light-house, the tower of which, composed of a solid mass of concrete, is 160 feet high, lighted by an electric light flashing every 20 seconds, and visible at a distance of 20 miles. Three other light-houses of the same height, though differing in construction, have been erected along the coast between the fort and Alexandria. It is interesting to know that the solid block of concrete or artificial stone so extensively used have, at least below water, become firmer and more trustworthy by reason of the growth of sea-weed upon them. Port Said is described in the latest edition of Mr. Murray's invaluable "Hand-book of Lower and Upper Egypt" as now regularly laid out in streets and squares, with docks, quays, churches, hospitals, mosques, and hotels, and all the adjuncts of a seaport, and with the most easily approached and safest harbor along the coast. Fresh water is supplied to it from Ismallia, that now famous half-way house of the canal voyage. The town, we are told, no longer presents the same busy appearance which it did when it was the head-quarters of the engineering work; but the increasing traffic through the isthmus always imparts a certain activity to the place.

The port of Suez, where more than one impatient captain, and we fear not a few equally impatient passengers, were probably yesterday anathematizing the bombardment and the obstinacy of Arabi Pasha, cannot boast of the almost romantic interest of the story of the great engineering enterprise which bade a town and port arise out of the sea. Yet here the whole of the ground on which the quays and other constructions stand has in like manner been recovered from the sea, and it is proposed, at some future time, to rescue the whole of the swamp lying between the town and the new ports (a distance of about two miles), which is now joined by a massive embankment of artificial stone, along which the road and railway pass. The entrance to the canal channel, protected by an extensive breakwater, is marked on the map as 27 feet in depth. The entrance to Port Ibrahim on the left of the voyager arriving from the Red Sea is divided by a long jetty into two parts, one for ships of war and the other for merchant ships. On the jetty, close to the quays to which the large steamers moor, is the station of the railway, Suez, unlike Port Said, being in communication with the whole net-work of Egyptian lines, affording easy access to Ismailia, Cairo, Mansurah, Damietta, Rosetta and Alexandria. The roadstead at Suez is capable of accommodating 500 vessels of all sizes. The actual town is of comprratively modern date, and, like Port Said, is dependent for its prosperity on the traffic through the canal. What remains of the ancient town is of little interest, and visitors to this part are mostly attracted by the magnificent view of the harbor, the roadstead, the mouth of the canal, the "range of Gebel Attakah, with its black-violet heights hemming in the Red Sea, the rosy peaks of Mount Sinai, and between the two the deep blue of the gulf."—*London News.*

EGYPTIAN WATER SUPPLY.

The Mahmudieh fresh-water canal, constructed by Mehemet Ali at a cost of 20,000 or 30,000 Egyptian lives, is once more playing its part in a nationa tragedy, having been dammed by Arabi Pasha with the two-fold object of depriving Alexandria of water, and flooding the surrounding country so as to make it impassible for troops and artillery. This Dutch method of warfare is of considerable antiquity in the East. Cyrus employed it against Babylon, the Persian General Megabyzus against the Greek garrison of an Egyptian fortress. In later days. Octai Khan, the great Mongol conqueror took Khiva by a dam which diverted the protecting stream of the Oxus into the channel which it still holds. The Duke of Parma used this device against Antwerp, Richelieu against La Rochelle. In the wars of Holland against Spain in the sixteenth, and France in the seventeenth century, its use was continual and effective. During the Russian campaign of 1873 in Central Asia, the Khivans, earning wisdom from their misfortunes, dammed the estuary of the Oxus to make it too shallow for the Russian gun-boats, while deepening the upper stream as an obstacle to their land force. The escape of several Union gun-boats by the timely construction of a dam from being stranded in a Southern river is still fresh in public memory.

THE GOTHARD TUNNEL.

THE motive power for the Gothard tunnel has been the subject of much investigation. The air in the tunnel is extemely hot, good ventilation by any means yet discovered is impracticable, and to have the locomotives for a heavy traffic discharge the products of combustion and the exhaust steam in it would, it is thought, make the passage extremely unpleasant for travellers and train men. It was proposed to have it worked by a travelling rope and a stationary engine, but this was dismissed without much consideration as likely to be inadequate for the heavy traffic expected. The management of the road seriously investigated the application of electric motors of the Siemens' system, and obtained plans and estimates from the Berlin firm. It purposed to put two copper cables 1 in. in diameter along the top of the tunnel, on which a small electric car should run, connected by a short cable with the train, each of which should be provided with two, three or four electric locomotives of 100 horse-power each, driven by a single engineman. The dynamo-electric machines were to be run by the turbines at the mouth of the tunnel which furnished the power for compressing he air for drilling during the construction of the tunnel, and the return current was to pass through the rails. The firm was willing to guarantee that the cables would deliver to the locomotives at least 50 per cent. of the power developed by the turbines, and the cost for the apparatus exclusive of the locomotives is reported at the comparatively trifling sum of $36,000, but the railroad company was apparently afraid to make the experiment.

Another plan was to work the road by means of compressed-air locomotives, which were actually employed during the construction of the tunnel; but the experience with these condemned them for other than construction trains. The engines had extraordinarily large tenders, but with these filled with air at a pressure of 180 lbs. per square inch, besides a large store in the engine itself, they could run but about 7,300 feet. To get through, great reservoirs were established at intervals along the tunnel, and 40 minutes of time was consumed simply in taking on supplies of air in a run of little more than three miles.

It was also proposed to run the trains with electric locomotives supplied by Faure accumulators, but the accumulators alone would make about all the load that the engines could haul at a low rate of speed, as has been shown before.

The conclusion was that for the present it is best to use ordinary steam locomotives, until further improvement has been made in other motors. Care is to be taken to have a good head of steam before entering the tunnel, and the fire under full headway, without fresh coal, and shut tight, so that the passage may be made without opening the fire-box door and with little escape of the gases of combustion. So far the traffic has been light, and there is a strong current through the tunnel from south to north, and the air is said not to be very bad.

The interior of the tunnel is saturated with moisture which is taken up by the current of warm air from the south, which grows warmer during its passage. Striking the colder body of air at the north end of the tunnel, it looses its capacity for moisture, and the water in it is precipitated in the form of a quite thick mist which always hangs about the northern entrance.—*R. R. Gazette.*

MECHANICAL PROGRESS OF THE FUTURE.

Thoughtful engineers, familiar with the work which has been done in mechanics during the last hundred years, have long wondered wether it was possible to continue mechanical progress in the next hundred years as has been done in the past, and the question has been invariably answered in the negative. It is true that the popular belief is that the possibilities of progress are in all directions unlimited, and that in mechanics alone we may go on year after year without hindrance. Such is not the case. In many lines of progress the engineer sees that with the present conditions he is already close to the limit which theory places before him. The steam engine, for example, using one-tenth of the power to be obtained from the coal, is vastly nearer what theory indicates to be its limit of economy than most people imagine. Indeed some of our best engineers, doing perhaps one-half better than that, are so near the end that comparatively little is to be hoped for. Two-tenths will practically be the limit, and we have already passed one-tenth. It is true that the great field of ærial navigation is likely soon to be opened to the mechanic, and yet even there, unassisted, the mechanic alone is hardly likely to be successful. The science of the future is undoubtedly chemical, and our great discoveries and greatest progress will be in that science. Mechanics, hereafter, may expect to take a subsidiary position and be the handmaiden of chemistry. The alkali industry, for example, one of the greatest of the age, has recently been progressing with a rapidity startling to those who have given but slight attention to it. For example, during the past year a product which has not only been wasted, but a most unmitigated nuisance to the community, has been turned to account, and from it during the past year one firm alone re covered 6,000 tons of sulphur, and five English firms, during the period covered by the last reports, recovered over 17,000 tons. In such a work as this chemistry plays a leading part, and mechanics takes a secondary position.

In the great Bessemer industry chemistry and mechanics have stood side by side; chemistry in general propounding the problems and pointing the way to the chemical solutions, and calling upon mechanics to find the means for carrying the work on. In the Old World many articles which, in this country are the objects of production, or, in other words, are made especially, are there simply by-products, made incidentally in establishments whose principal business is some other more important manufacture. Not infrequently some manufacturer finds that by the introduction of a chemical process into his establishment, waste products which he has been compelled, at heavy expense, to throw away, are converted into valueable commodities. It is not beyond possibility for the user of power and the chemist to be found side by side, the chemist in his work, perhaps, furnishing the motive force of the mechanic, and possibly as a waste product. Indeed, we know of dye works where 1,000 horse-power is produced at an expense of fuel actually below the theoretical. Steam already made is run through the engine and its pressure reduced till it reaches that needed in the works. The fuel for the power is merely that needed for raising the steam 20 or 30 pounds in pressure. The cost of making the steam falls upon the dye works.

NOTES.

IRONCLAD SHIPS.

The thickest armor in the British navy is that of the Inflexible, one of the ships that bombarded Alexandria. It varies in thickness, in different parts of the ship, from 16 to 24 inches. The Italian Government is building two ships which will have armor 36 inches thick. The Italian ships Duilio and Dandolo have armor 22 inches thick throughout, making them, upon the whole, more heavily armored than the Inflexible. Their armament is also heavier, as they carry 100-ton guns, against the Inflexible's 81-ton guns.

AFRICAN EXPLORATION.

An expedition, under the command of Rogozinski, an officer of the French navy, is about to explore the tract of country between the Gulf of Guinea, the Chary, and the Congo. No European has ever visited this region, in the centre of which, according to the natives, there is a large lake (the Liba), from which the Chary and other rivers flow into the Bay of Biafra derive their source. Rogozinski takes seven or eight Europeans with him, and he intends to establish on Mount Cameron, at the extremity of the Bay of Biafra, a geographical and meteorological observatory.

THE EFFICIENCY OF INCANDESCENT ELECTRIC LAMPS.

A committee, consisting of Prof. George F Barker, of Philadelphia; William Crookes, of London, and others, made a series of experiments on the incandescent electric lamps exhibited at Paris last year. The following are the conclusions reached after elaborate tests, as given in the report of the committee:

1st. The maximum efficiency of incandescent lamps in the present state of the subject, and within the experimental limits of this investigation, cannot be assumed to exceed 300 candle-lights per horse-power of current.

2d. The economy of all lamps of this kind is greater at high than at low incandescence.

3d. The economy of light-production is greater in high resistance lamps than in those of low resistance, thus agreeing with the economy of distribution.

4th. The relative efficiency of the four lamps examined, expressed in Carcel burners of 7.4 spermacetti candles each, produced by one horse-power of current, is as follows: (A) At 16 candles: Edison, 26.5; Swan, 24; Lane-Fox, 23.5; and Maxim, 20.4. (B) At 32 candles: Edison, 41.5; Lane-Fox, 37.4; Swan, 35.5; and Maxim, 32.4. To double the light given by these lamps, the current-energy was increased, for the Maxim and Lane-Fox lamps, 26 per cent.; for the Edison lamp, 28 per cent.; and for the Swan lamp, 37 per cent.—*Engineering and Mining Journal.*

ALEXANDRIA'S WATER SUPPLY.

A THREATENED WATER FAMINE IN ALEXANDRIA.

LONDON, July 24.—The *News* has the following:

ALEXANDRIA, July 23.—The staff of the water-works are hard at work cleaning the Roman cisterns for the storage of water. It is a race between the falling level of the canal and the dauntless energy of the English engineers. If only water enough can be stored to tide over another month, the Nile inundation will probably sweep away Arabi's dike or rush around it, and all will be well.

THE RAMLEH WATER-WORKS.

Arabi Pasha has massed 700 cavalry with a field gun at the pumping station of the Ramleh water-works. It is supposed his intention is to destroy the station.

CONDENSING WATER.

To provide for the civil population the Chief Engineer of the Bittern has been placed in charge of the steam cotton works, where, with five boilers and two tanks, he will be able to condense 100 tons of water daily from wells of brackish water.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

WILL HAVE WATER-WORKS.—The corporation of Bellows Falls, Vt., has at last ended the question of additional water supply. Norman H. Farr recently bought of the Cheshire Provident Institution, of Keene, N. H., the pasture land near Menard's pond for $1,500, and three acres of this, with the privileges and appurtenances for overflowing, damming and piping, he conveys to the Bellows Falls village corporation for $300.

THE NATIONAL GAS COMPANY, Norristown, is full of orders for special apparatus designed for the manufacture of the Lowe process gas. The new works at Cape May were designed and built at the Norristown shops of this company. A complete set for an interior city of Pennsylvania has just been finished.

WATER SUPPLY WANTED AT YORKVILLE, CANADA.—The water-works engineer having reported that the supply was considerably less than last summer, and that unless some immediate action to remedy matters was taken the residents would be without water, a meeting of ratepayers was held on Tuesday night at Mr. Severn's residence. The chair was occupied by Mr. A. Harvey, who said that prompt steps would have to be taken in regard to the insufficient supply. It was decided that the chairman should wait upon the Corporation of Parkdale and ascertain the probable cost of supplying Yorkville with water.—*Toronto Mail.*

WATER METERS.—The city engineer and manager of the water-works of Toronto, Can., has been instructed to report at an early day the state of the water meters of that city.

THE WATER QUESTION AT GALESBURG.—GALESBURG, Ill., July 24.—The question of water-supply in this city has long been a problem that has puzzled the wisest heads to solve. Mr. W. R. Coats, a civil engineer from Michigan, has been here for several weeks prospecting and experimenting. The result was a report to the city council last Saturday night, recommending Crystal Springs Park as promising an inexhaustible supply. The city clerk was thereupon instructed to call an election, to be held Aug. 22, to vote on the following propositions: For or against purchasing the Crystal Springs; for or against issuing of city bonds for $18,000, with which to build the water-works, $12,000 having already been appropriated, and for or against appropriating $5,000, for the purpose of erecting a public library building.

WATER SUPPLY OF SWAMPSCOTT, MASS.—The people are quite jubilant over the prospect of an immediate water supply through the agency of the Swampscott Water Company, whose experiments with tubular wells in the basin of Stacy's Brook were noted a few days ago. The manager of the experiment says the directors are feeling satisfied with the yield and quality of the water and are ready to pipe the town, erect a standpipe on some lofty spot, put in a double pumping engine having a daily capacity of from 1,000,000 to 2,000,000 gallons, and erect other paraphernalia of water works. The contract for the pipe will be awarded very soon, the quality to be the Boston standard, which is claimed to be superior to that used in the neighboring city of Lynn. A 12-inch pipe will be laid from the pumping station, off New Ocean street, through this street to Burrill street, and thence in a direct line to a point beyond the Ocean House. Pipes of good capacity will be laid elsewhere. The hotel managers and many private families have been caused much trouble and expense in securing water in the past, and owners of water carts have done quite a lucrative business at times in supplying their places. To sum up the disavantages under which the citizens have labored, it is sufficient to say that they have been put to great inconvenience and considerable cost. For these reasons they are thirsty for a modern supply, and therefore give the water company every encouragement. The present pumping station was inspected on Monday, when it was found that a pump having a capacity of 8.8 gallons per stroke was pumping 56 strokes to the minute, which was increased to 60, showing that the pumping was at the rate of over 700,000 gallons for a day of 24 hours at the former rate, and over 750,000 gallons at the latter rate. The boiler was not sufficiently large to run the pump at a higher service. The water is drawn from eighteen tubular wells sunk to a depth of thirty feet. The wells first penetrated loam and gravel to a depth of seven or eight feet, and next a bed of clay having a uniform depth of eight feet. Following this was found fine sand, and next was water gravel, from which deposit the supply is drawn. This basin, which is at about sea level, is supposed to be fed by innumerable springs within a large section of territory. The water is clear, has a nice taste, and is cool. A thermometer indicating 100 deg. was thrust into the water Monday, and in a few seconds it indicated 48°. The detailed result of an analysis of the the water is not known, but the managers say it is of excellent quality. Some samples are now being analysed in Boston. A few people think the water will be rather hard for some purposes. The company's officers believe the water will be suitable for all domestic purposes and will be pure. The supply is deemed to be far greater than would be demanded. A million gallons daily is set as the easy capacity of the works, while the consumption would not be over 250,000 gallons daily if every house in Swampscott had connection. The steady pumping has very little effect upon the yield. The wells cannot be lowered less than nine feet from the surface by the present pump. On Monday the pump was stopped two minutes, and during that time the water rose 21¼ in. in the wells. Pumping is stopped at night, and on the next morning the wells are found to be overflowing. But little sand is raised by pumping. On the first day there was a bushel of the sand raised, on the second day one-half bushel, on the third day one peck, and for the past three days one-half peck altogether. Definite information as to street pipes, the position of the standpipe, etc., will be had within a few days. The officials give the assurance that the works will be pushed with all possible speed.—*Boston Journal, July 25.*

AUDUBON (Neb.) has voted to have water-works.

WATER SUPPLY AND TAXES.—The tax-rate of Orange, N. J., has been fixed at 2.66. This is the highest rate ever known in that city, but the excess is occasioned by the fact that the authorities have just completed arrangements for a new water supply.

WATER SUPPLY EXTENSION.—The Grand Rapids (Mich.) City Council has voted to submit a proposition to the people of issuing bonds in the sum of $100,000, to be used in extending the water mains.

THE construction of the Paris, Ont., water-works is to be proceeded with at once.

THE city of Negaunee, Mich., offers $25,000 bonus to any company which will provide the city with water-works.

THE Holly Mfg. Co. have recently secured contracts for pumping engines, 3,000,000 daily capacity, for Fort Worth, Tex.; also, for Austin, Tex.; engine for 2,000,000 daily capacity for Atlantic City, Iowa, and for water-works complete for Manistee, Mich., including 6 miles 7-in. pipe, 50 hydrants, and pumping engines, 2,000,000 galls. daily capacity.

TO BUILD GAS WORKS.—A company proposes to put in gas-works at Atlantic, Ia., and furnish gas at $2.50 per thousand feet.

TO INCREASE THE WATER SUPPLY.—Chief Engineer Van Buren is perfecting plans to increase Brooklyn's water supply by about 5,000,000 gallons a day, at an expense of less than $200,000.

ELECTRICITY.

THE TELEPHONE IN NEW HAMPSHIRE.—Through telephone connection has been made from Plymouth through Ashland, Meredith, Laconia and other places to Franklin. The telephone line is being extended to East Swanzey and Marlboro depot and will probably be built to the county almshouse at Westmoreland, with stations at South Village and Parkhill.

THERE is talk of putting six powerful electric lights on top of Mt. Washington.

ELECTRICITY IN EGYPT.—The electric light has been established in the forts.

THE Electric Light Company, at Fond du Lac, Wis., have decided to put in five hundred of Edison's incandescent lights for lighting private dwellings and stores.

TWENTY-FIVE electric lamps are being placed in the Mining Exposition building, at Denver, which is to open next week. Utah has contributed a block of refined silver valued at $118,000. There are three samples of high-grade ore, weighing over a ton each.

THE long deferred "lighting up" in the first district of the Edison Electric Light Company, it is now expected, will take place about the 1st of September. The district is bounded by Spruce, Nassau and Wall streets and the East River. After more than a year of steady labor all of the mains have been laid, houses and offices have been "wired" for about 14,500 lamps, and elaborate and costly machinery has been constructed in the central station on Pearl street.

A NEW TRANSATLANTIC CABLE.—LONDON, July 22.—The prospectus has been issued of the European, American, Canadian and Asiatic Cable Company. The capital stock of the company is £1,500,000. The company proposes to work at a rate of ninepence per word. The prospectus provides for the establishment of the necessary land and water communications for connecting points in Canada with New York City on one side, and for the laying of the company's cable from Canada to Europe on the other.

ELECTRIC LAMPS IN SPRINGFIELD, MASS.—There are 60 electric lamps in use in the city and each one that is burned nightly has to be put in order just as though it were an oil lamp that needed trimming. The man in charge takes out the carbons which were burned the night before, so that their points may be ground over, replacing them with others that have been sharpened. The city electric lamps are soon to be provided with globes to protect them from the wind and give a steadier light. These lamps occasionally let fall pieces of burning carbon, and people who pass under them will do well to be on their guard. Bad boys have been in the habit of lowering and raising the Court square lamp according to their own sweet will, and the company have placed the end of the hoisting rope in a lock-box attached to one of the trees to end their sport.—*Springfield Republican.*

RIVERS AND HARBORS.

QUEBEC HARBOR IMPROVEMENTS.—QUEBEC, July 26.—Mr. Askwith, of Ottawa, having declined the contract for the new harbor works, Larkin, Connolly & Co., of St. Catharines, Ont., graving dock contractors, the next lowest tenderers, have put up the deposit of $10,000 required by the Commissioners before being awarded the contract. Their tender is $8,000 higher that Askwith's, which was for $150,000. They have all the plant necessary for the undertaking on the Welland Canal. The award has been referred to Ottawa for ratification.

STREETS, DRAINAGE, ETC.

TORONTO PAVEMENTS.—We give the results of bids for cedar block paving in Toronto, Canada, in the following table. The contracts were awarded on the 18th. Queen street will cost about $150,000, and the other streets $50,000. Yonge street has just been finished with cedar block, stone curb, roadway 42 feet wide; cost $60,000. The bidding for Queen street and others was very close, so that the figures awarded give a good indication of all the others.

ABSTRACT OF TENDERS FOR WOOD PAVING QUEEN ST., TORONTO, CANADA.

Names of Successful Bidders.	Sections.	Curbing.	Crossing Plates —100 lbs.	Moving Tracks—per 100 Lineal feet.	Wood Curbing—per Lineal foot.	Pavement—per Square yard.
John McBean	River Dam to Parliament street	Wood.	$2.50	$18.60	25	$1.16
John T. Pearce	Parliament to Jarvis	"	3.50	30.00	25	1.23
John T. Pearce	Jarvis to Yonge	"	3.50	30.00	24	1.24
Richard Dennis	Yonge to Brock	"	2.90	22.50	86	1.16
Richard Dennis	Brock to Bathurst	"	2.50	22.50	84	1.10
Richard Dennis	Bathurst to Strachan	"	3.50	20.00	85	1.28
Alex. W. Godson	Strachan to Dundas	"	3.00	18.00	70	1.18
Richard West	Dundas to Railway Crossings	"	3.00	18.00	97	1.17
Richard West	Railway Crossings to Brock	"	3.00	15.00	90	1.15
Richard West	Brock street. King to Queen street	"	3.50	15.00	27	1.05
Richard Dennis	Brock street. King to Front street	"	3.75		25	†1.19
Richard West	Brock street. Queen street to bend	"	3.50		30	1.19
Richard Dennis	Dundas street. Queen to Conway street	"	3.50		90	†1.03
Richard Dennis	Strachan street. Church to Jarvis street	"	3.50		57	1.04
A. W. Godson	Charles street. Wilton avenue to Gerard street	"			57	1.14
A. W. Godson	Berkeley street. Between Front and Esplanade sts., Yonge to Scott sts	"			100	1.14
John McBean	Lane.	"			85	*2.75
Geo. Farquhar	Lane. Bet. Yonge and Jordan sts., Melinda to Wellington sts.	"				*3.00

* Stone.
† With tar composition.

SANITARY IMPROVEMENTS.—Blakeslee & Sons have just finished filling the meadow near the Consolidated depot at Meriden, Mass., a job costing $10,000. The same firm have a $10,000 contract for paving certain streets at Bridgeport.

THE STRATHROY (Canada) Town Council has asked for tenders for a number of asphalt sidewalks.

A NEW HAVEN PROJECT.—New Haven looks with some favor on a project to spend $1,000,000 in narrowing West River into a canal, constructing a long sewer besides, and laying out a boulevard over the marshes.

ABOLISHING NARROW TIRES.—Davenport's City Council has passed an ordinance against the narrow-tired wheels that were ruining its macadamized streets, taxing all carrying over 5,500 pounds.

THE SOUTH MILL POND NUISANCE.—At a meeting of the Aldermen of Salem, Mass., the Committee on South Mill Pond reported a plan for abating the nuisance there existing as follows: That the bottom of the culverts or arches under Mill street be deepened to about 6½ ft below high water line, which would require rebuilding the masonry; that the bottom of the Mill Pond, from Mill street to the culvert under the Eastern Railroad, be excavated 20 ft. wide and to a depth of 6½ ft. below high-water line; that a canal 10 ft. wide be built from the eastern culvert, under the Eastern Railroad, to the railroad culvert, near Castle Hill, while the culvert be largely improved; also that the pond bed be deepened to a distance of 400 ft. south of Mill street, and that other minor pieces of work be performed. The gross

cost would not exceed $33,075. The Eastern Railroad has submitted propositions, in which that company agrees to make improvements at the Mill street outlet, rebuild the two railroad culverts and dredge the pond from Mill street to the first culvert—all this, providing the company shall be freed from further responsibility with the pond matter. The Aldermen authorized the contract to be made as above, provided a slight modification can be made in the Railroad's proposition about the improvement at Mill street. The bill was sent down to the Council.—*Boston Journal.*

GRADING.—The St. Paul, Minn., board of public works has reported favorably on grading Seventh street. The estimated cost is $160,000.

PAVING.—It is estimated that the cost of paving already provided for in Springfield, Ill., by ordinance will be $93,458.

RAILROADS.

NOVA SCOTIA RAILWAYS.—The engineers of the short line railway have completed the final survey of the railway from Oxford to Pugwash, N. S., a distance of about eighteen miles, shortening the previous survey some two miles, and getting a very good line. They have commenced a survey from the junction of the Pugwash road towards New Glasgow, N. S., to meet the other surveyors. Col. W. S. Greene, Chief Engineer, is expected to return from New York in a few days to commence the construction of the road already located, and it is understood to be the intention of the company to proceed with the work as rapidly as possible.

THE RAIL MARKET.—Steel rails are quiet, with little new business reported. Quotations continue at $48 to $50 per ton at mill. Iron rails are dull, and only small sales are reported. Quotations are $45 to $48 per ton at mill, according to section, but it is probable that large orders could be placed a little lower. Spikes are active at $3.10 to $3.15 per 100 lbs.; fish-plates, a little lower at $2.50 to $2.70; track-bolts, $3.75 to $4.25. Old iron rails are quiet with few sales reported. Quotations are $26 to $27 per ton in Philadelphia for tees, and $28 for double-heads.

PRICES OF SCRAP.—Pittsburgh quotations for scrap iron and steel are as follows: Old car wheels, $26 to $27; cast borings, $15 to $16; crop ends, $26 to $26.50; wrought turnings, $20 to $22; No. 1 wrought scrap, $27 to $29; old car springs and steel axles, $38 to $40. Quotations for cast iron and crop ends are per gross ton; for wrought iron and steel, per net ton.

GRADING COMMENCED.—The work of grading the railroad from Bridgton to Hiram, Maine, is being actively pushed, work having been commenced last week.

SMITHVILLE and Morehead, N. C., are now connected by rail.

THE CINCINNATI, VAN WERT & MICHIGAN RAILROAD, now constructing through the western tier of counties in Ohio, is being rapidly extended toward Cincinnati. It is now in operation from Paulding, the county seat of Paulding County, through Van Wert to Shane's Crossing, in Mercer County — some 32 miles. This part of the road passes through the largest body of timber now standing in Ohio, and is doing a large and profitable business. It is expected that the track will be laid to Greenville this fall; from Greenville a very good connection will be made via Dayton to Cincinnati.

NEW STYLE OF COACHES.—The Pennsylvania Company are now building all their passenger coaches one foot narrower than the ordinary pattern, reducing the width by making the alley more narrow. The object is to make the car lighter and to lessen the resistance. The pattern adopted reduces the weight 5 per cent., and the resistance fully 10 per cent., yet the coach is just as convenient and rides easier than the ordinary wide coach.

THE amount of coal consumed annually on the New York Central road, between Albany and Buffalo, is from 800,000 to 900,000 tons.

THE NEW DENVER CUT-OFF OF THE BURLINGTON.—The surveyors recently sent out by the managers of the Chicago, Burlington & Quincy to locate a line from some point between Hastings and Kearney to Arapahoe, Neb., in order to shorten its lines to Denver, as the present line from Hastings to Red Cloud forces the road to make a considerable detour to the southward, have completed their work and report in favor of a short cut from Kenesaw, on the Kearney Branch, to Arapahoe. The new link will be 80 miles long and will shorten the distance between Chicago and Denver 25 miles. With the completion of this new line the Burlington will have the shortest line to Denver from Chicago by about 30 miles. Construction on the new cut-off will commence next spring, it being too late in the season to commence work now.

THE ROAD WILL BE BUILT.—MONTPELIER, Ind., July 24.—The Bluffton & Union City Railroad Company has negotiated a sufficient loan with Eastern capitalists to build the entire line, and work will commence immediately.

WORK has been begun on the Wisconsin, Iowa & Nebraska Railroad near Waterloo. Grading is also being done near Marshalltown, and the two forces are working toward each other. It is expected that cars will be running between Marshalltown and Waterloo before the end of the year.

TRACK-LAYING on the Springfield & Memphis road, between the crossing below Walnut Ridge, Ark., and Black River has begun.

NEW KANSAS COMPANIES.—Charters have been filed with the Secretary of State of Kansas for the following new railroads: The Atchison & Southwestern Railroad Company, with headquarters at Atchison; capital stock, $2,000,000; directors, J. P. Brown, J. H. Beeson, C. C. Burnes, J. P. Pomeroy, Henry Low, F. D. Mills, E. R. Purcell and Philip Zepin. This road is to run from Atchison in a southwesterly direction, through the counties of Atchison, Jackson, Pottawatomie and Riley, to some point on the Kansas River, a distance of about 100 miles. The Blue River Railroad Company; the road is to run from Manhattan, Riley County, in a northerly course along the Blue River, through the counties of Riley, Pottawatomie and Marshall, a distance of about 60 miles; capital stock, $1,000,000. The business of the company will be transacted at Atchison, and the directors are F. D. Miles, J. H. Beeson, Henry Low, Frank Schweerdt, John McPherson, L. R. Elliott and E. B. Purcell.

GRADING COMPLETED.—A Neenah (Wis.) dispatch says: "The Milwaukee & Lake Winnebago Railroad Company has been laying rails south of Neenah. Trains will be running between Neenah and Fond du Lac inside of thirty days, providing the right of way through Oshkosh is secured by the time the rails are laid that far. The grading is all completed."

OVER THE ST. LAWRENCE.—The Atlantic & Northwestern Railway has acquired the right of way to span the River St. Lawrence above the Lachine Rapids. The water is deep there, but the distance is less than in some localities.

THE CANADIAN PACIFIC.—A dispatch from Winnipeg has been received to-day by Messrs. J. S. Kennedy & Co., agents of the Canadian Pacific Railway Company in this city, from Mr. George Stephen, President of the company, in which he says: "I have just returned from the end of the track, which is now 295 miles west of Winnipeg. Contractors are laying from three to four miles a day, and, barring accidents, I have now no doubt of our completing 500 miles of main-line track this season, bringing the locomotive 50 miles west of the Saskatchewan River by December next. Crops are looking splendidly, and traffic on the part of the line in operation will foot up this year about $2,000,000, exclusive of the earnings on the Eastern Division."

SARATOGA, MT. MCGREGOR & LAKE GEORGE RAILROAD.—Guage 3 ft. Length 10½ miles. Work begun March 17 last. First train through to end of line, July 16. Road opened to public on the 17th. Difference in elevation of termini, 800 ft. The whole work has been carried forward under the direct superintendence of John McGee, Engineer and Superintendent. The two engines now on hand are intended for the mountain grade only, where sharp curves make hard pulling and require moderate speed. The engine for use between Saratoga and the heavy grades did not arrive in time for the opening of the road as was intended. This one will draw to the foot of Mt. McGregor a train that will require the power of the two mountain engines to take it to the top of the mountain. The two mountain engines as yet fall short of the performance promised by the manufacturer. It is expected, however, that as the track improves and the engines become worn down to smooth working that they will increase their effective power considerably. On the mountain grades 24-degree curves (of 260 ft. radius) are frequent. A steady grade of four ft. rise to the hundred (211 ft. per mile) is maintained except at the beginning of the mountain grade, where it was necessary to adopt a grade of 232 ft. to the mile for a distance of three-quarters of a mile. The work of the mountain was difficult, slow and expensive. Several very large trestles were needed, some of which are 35 to 40 ft. high up to 330 ft. long, and others on sharp curves. In the first 2½ miles of line from the summit only one-half (as the crow flies) of distance is made from the starting point, the two miles of extra distance being developed to make the rise needed to reach the top of the mountain. It is to the credit of the manner in which the work has been carried out that notwithstanding the difficult and dangerous character of much of it and the hurry in doing it that time has been taken to do the work safely. Not a fatal accident, nor even a serious one, has occurred in its prosecution.

CANALS.

CONNECTING THE RHONE AND LOIRE.—According to *Engineering* the proposed connecting of the Rhone and Loire rivers (France) by a canal contemplates the employment of Captain Eads' plan of carrying boats up two long inclines by means of railways. To prevent injury to the boats, they will be floated in iron cisterns resting on railway trucks. The trucks will be helped up the incline by the gravity of barges in an opposite direction.

CONTRACTS.

LAFAYETTE, Ind., July 19.—The County Commissioners are having prepared a transcript in the court-house case, with a view of trying again in the Supreme Court. They last week invited bids for the work of completing the court-house. The only question involved in the appeal, outside of the expense, is whether or not the County Commissioners can go on and build the court-house without advertising for bids. They claim they can—the County Court said they could not.

THE village of Escanaba, Mich., is to build a new court-house. The bids are advertised to be opened yesterday, the 28th.

PATERSON IMPROVEMENTS STOPPED.—Judge Dixon, of Jersey City, has granted a supersedeas stopping all the proposed permanent street improvements in Paterson, for which contracts were about being executed, and certiorared the matter to the November term of the Supreme Court to decide the legality of the proceedings that had been taken. The proposed improvements were to cost between $40,000 and $50,000, and the contracts had all been awarded, but not signed. The grounds of the application were that the proceedings were not legal, on account of not conforming with the wording of the city charter.

CONTRACTS LET.

CLARKE, REEVES & CO., at Phœnixville, Pa., have the contract for the new bridge over the Susquehanna at Lewisburg, Pa., on the Philadelphia & Reading's new line to Williamsport. It will be 2,400 ft. long, in 10 spans, and is to be finished by the end of November.

THE Central Bridge Co., of Buffalo, N. Y., has the contract for the bridge over the Delaware River at Portland, Pa., for the Pennsylvania, Slatington & New England road.

A BUILDING CONTRACT LET.—The contract for building the foundry and store-house of the Holyoke, Mass., foundry company has been given to Lynch Bros. for $16,037. The buildings are expected to be ready for use by Sept. 21. Lynch Bros. have sublet the wood and iron work to F. F. O'Neil.

A PAVING CONTRACT LET.—The contract for paving Main street, Holyoke, Mass., from Dwight to Appleton, was awarded yesterday to Daniel O'Connell at the rate of $2.60 a square yard, the material to be Cheshire granite. There were seven bids.

A BRIDGE CONTRACT LET.—The Cleveland (O.) *Leader* says: A contract has just been awarded to the Smith Bridge Company, of Toledo, by the Cleveland, Akron & Columbus Railway, for the erection of five iron bridges, one near Hudson, one near Akron, and three between Akron and Orrville. These bridges are designed to carry the heaviest freight engines built.

TOWN HALL AT DOYLESTOWN, O.—The bids for building the Town Hall were opened Friday, June 30th. J. C. Etling's was the only bid for brick work—$3.25 per thousand and to furnish brick in excess of those on hand at $6 per thousand. W. G. Biglow's was the only bid for woodwork—$2,450. Jacob Shook's bid was the lowest for masonry—$450. Jacob Dies' bid was the lowest for plastering—$181. J. J. Hower's bid was the lowest for roofing and spouting—$190. No bid was put in for painting.

BOSTON BRICK CONTRACT LET.—The Committee on Improved Sewerage has made a contract with the Brewer Brick Co. of Bangor to furnish 1,000,000 bricks during the coming fall, at $9.50 per 1,000. Between 20,000 and 30,000 brick are used each day in the lining of the tunnel to Moon Island, and it will take about eight months to complete the work.

THE contract for constructing the steel barbed wire fencing on the eastern division of the Canada Atlantic Railway has been awarded to Mr. Lockie Wilson, of Glengarry. This contract embraces 150 miles of fencing and about 1,000 gates.

BUILDING.

TORONTO, Can., wants a new city hall, as the present building is inadequate for its requirements.

BUILDING OPERATIONS IN HOLYOKE, MASS.—Some of the contractors are offering to lay brick for $9.50 a thousand and cannot find employment for their men at those figures, which leads many to suppose that the price will drop to $9 a thousand before fall. As a consequence, quite a number who had determined not to build this season are again talking of erecting houses, and it would not be strange if a brisk business was done in building before the snow flies. Some of the prominent builders have very few jobs on hand, and as soon as these are finished it will be difficult for them to keep their men busy.

WESTPOINT, Va., is to have a large hotel.

THE Iowa capitol, begun in 1871, is nearing completion. Estimated cost, $1,500,000; actual, $2,500,000—and it is to have a gilded dome.

THE NEW UNION DEPOT at Reed City, Mich., is to cost $14,000.

CHURCH.—A $10,000 Methodist church is to be built at Ridgefield, Conn.

PRICE OF BRICKS IN TORONTO, CANADA.—A writer in the *Globe* states that since the spring supply of bricks came prices have steadily decreased and are now as low as they have been for years.

SIOUX COUNTY, Iowa, is to have a $6,000 stone jail.

LABOR.

WAGES, PRICES AND PROFITS IN MASS.—In the current Princeton *Review*, Carroll D. Wright makes the deduction from an elaborate comparison of wages, prices and profits in Massachusetts from 1860 to 1881 that, covering the whole period of 21 years, there has been an average increase in wages of 31.2 per cent., and in prices of 41.3 per cent; in other words, that the workingman has suffered a reduction of 10 per cent. in the purchasing power of his wages; but that this reduction is only temporary, the general tendency being to elevate wages, which tendency has steadily increased for the past 100 years. Mr. Wright believes that a too rigid economy reacts upon consumption and so cripples wages; that machinery on the whole favors wages; that railroads and other capitalized developments of transportation are also beneficial to the wage-receiver, while trades-unions and co-operative production are not; and that in the end the workingman must turn to himself for the only true solution of the financial difficulties, by becoming something more than a machine, and putting himself at his best as to skill, faithfulness and temperance, and temperance in the largest sense of lopping off all superfluous and harmful habits and expenditures.

CHINESE LABORERS.—There are 4,050 Chinamen employed on the Canada Pacific Railway work in British Columbia, and that number will be increased to 6,000 in August.

BRIDGES.

THE work on the addition to the Philadelphia Bridge Works, Pottstown, Pa., is being pushed forward as rapidly as possible. A large hammer is to go into the blacksmith shop. Among contracts on hand is one for three hundred dozen axles for the Philadelphia & Reading Railroad Company.

THE Dominion Bridge Company will, according to the *Toronto Globe*, have its head office in Toronto. The company comprises Messrs. Job Abbott, civil engineer, and Phelps Johnson, civil engineer, both of Toronto; Angus Thom, Montreal; Henry Macfarlane, contractor, of Stratford, Ont.; and Luke Lyman, Probate Judge of Northampton, Mass. The capital stock is $500,000.

THE proposed bridge between Moorhead and Fargo, D. T., is in a fair way of being built.

WORK on the big bridge across the Missouri at Bismarck, D. T., is progressing rapidly.